Vol. 12, No. 19
October 15, 1987

Energy Research Abstracts

Abstracts 38419-40319

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

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Energy Abstracts for Policy Analysis (EAPA)

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Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available as PB87-946800 from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 on a standing order basis through an NTIS Deposit Account. To establish an NTIS account, send the minimum $25.00 deposit to NTIS, Attn: Customer Accounts. A single issue is $12.00 for domestic (North America) and $24.00 for foreign (outside North America).

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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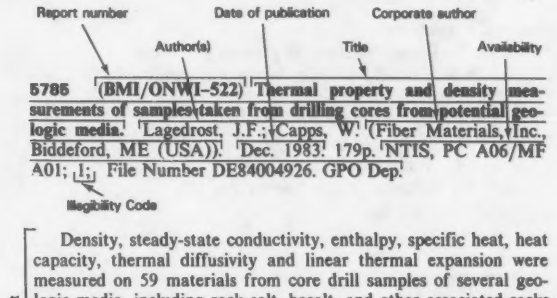
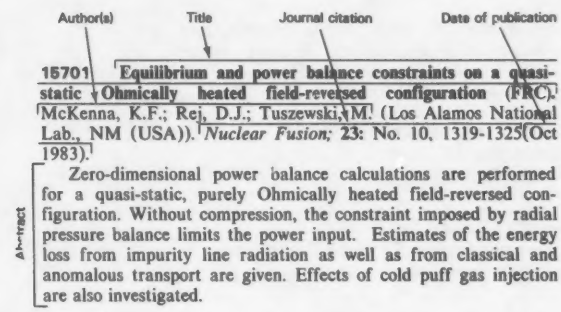
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Illegibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
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Bethesda, MD

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Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

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0103 Preparation

REFER ALSO TO CITATION(S) 38434, 38477

38419 **(CONF-850982—4) The effect of fine grinding on the production of superclean coal by flotation.** Miller, K.J.; Wen, Wu-Wey. (USDOE Pittsburgh Energy Technology Center, PA). Sep 1985. 6p. NTIS, PC A02. File Number DE87011814.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Because of the growing need to develop new technology for producing superior quality coals to replace oil and natural gas, the US Department of Energy's Coal Preparation Division is looking at fine grinding and multistage flotation processes to maximize the liberation and removal of sulfur-bearing and ash-forming mineral matter from coal. The beneficiation of micronized coal by froth flotation has long been considered unsatisfactory because of poor product quality and/or poor recovery. However, recent studies have shown that ultrafine coal can be cleaned to very low-ash levels if the appropriate grinding procedure is used to prepare the coal and if a relatively low ash feed is used. For example, wet grinding assures a much lower ash froth concentrate than does dry grinding. In addition, work now in progress suggests that superclean products of high yield can be obtained by a combination of coarse coal cleaning or rougher flotation, followed by wet grinding and reclining by second-stage and third-stage coal flotation. For example, by a combination of rougher flotation, wet grinding of the rougher concentrate, and two-stage coal flotation of the wet-ground product, an Upper Freeport bed coal sample was cleaned from 26% ash and 1.1% pyritic sulfur to 4.5% ash and 0.1% pyritic sulfur. 4 refs., 7 figs., 8 tabs.

38420 **(CONF-850982—5) Round robin testing of advanced selective agglomeration and flotation processes.** Killmeyer, R.P. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 5p. NTIS, PC A02. File Number DE87011807.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

For the 28 mesh by 0 coal, the emerging selective agglomeration and flotation technologies (mainly C1, D1, F1, E1) show the following: (1) The various processes have similar efficiencies with regard to yield/ash relationships at high Btu recoveries. (2) Most of the processes can achieve the optimum grade/recovery relationship predicted by washability analysis. (3) All are significantly better than conventional froth flotation. (4) All can achieve exceptionally high Btu recoveries but differ with regard to ash rejection. For the 400 mesh by 0 and finer coal, the emerging selective agglomeration and flotation technologies show the following: (1) Comminution from 28 mesh top size to 400 mesh top size and below can produce a significant improvement in the grade/recovery relationship (for this particular coal). (2) The spread in efficiencies suggests that the comminution/liberation step could be as important as the separation step. (3) Processes E2 and F2 can produce exceptionally sharp separations on ultrafine coal, as opposed to Process 82's apparent inability. (4) For this coal, significant pyritic sulfur liberation occurs by grinding to ultrafine sizes, and it can be removed efficiently. (5) All the processes can produce a fairly low-ash coal but differ with regard to Btu recovery. While these processes are significantly more efficient than conventional froth flotation, they are also more expensive owing to the use of costly agglomerants or parting-liquid recovery techniques, multistage cleaning steps, grinding costs, or special operating conditions. Their efficacy must ultimately be decided in terms of their cost effectiveness. The marketplace will decide whether the price of the premium quality clean coal product or the value of the increased Btu recovery makes up for the increased processing cost. 1 fig., 4 tabs.

38421 **(CONF-850997—2) Coal desulfurization by physical, chemical, and microbial beneficiation in the United States.** Deurbrouck, A.W. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 5p. NTIS, PC A02. File Number DE87011810.

From International symposium on mining technology and science; Xuzhou, China (18 Sep 1985).

Exciting new beneficiation techniques are being developed in response to the need to further desulfurize and demineralize coals. Some show promise for immediate application, whereas others are still in early stages of research and development. However, significant progress has been made in the last few years in the development of these new techniques, and it is reasonable to anticipate that intensive coal beneficiation will continue to gain acceptance as the technology of choice to meet environmental standards economically and thus encourage greater utilization of coal, the most abundant energy resource in the United States. 13 refs., 3 figs., 6 tabs.

38422 **(CONF-860548—6) Recent advances in ultrafine coal beneficiation at PETC [Pittsburgh Energy Technology Center].** Killmeyer, R.P. (USDOE Pittsburgh Energy Technology Center, PA). May 1986. 7p. NTIS, PC A02. File Number DE87011806.

From 8. international symposium on coal slurry fuels preparation and utilization; Orlando, FL, USA (27 May 1986).

Over the last few years, the objective of the DOE Office of Fossil Energy coal preparation program has been, and still is, to develop coal preparation technology that can reduce the ash and sulfur content of raw coal so that the product can be used directly as a clean fuel that could replace oil and natural gas and reduce environmental emissions. The objectives of the coal cleaning and coal slurry fuels programs are almost identical, and actually need to be integrated in order to achieve some of them. Beneficiation to superclean levels requires near-complete liberation of coal from its associated impurities, and this, in turn, requires comminution to ultrafine sizes (<74 microns). Thus the focus of each project in the coal preparation program is on the potential problems presented by beneficiating ultrafine particles as opposed to conventional size particles. This paper highlights six projects currently being conducted in PETC's Coal Preparation Division: centrifugal float-sink, automated petrography, heavy-liquid cycloning, dry electrostatic separation, froth flotation, and fundamental coal surface science. The objective and background of each project are discussed, along with recent progress and future directions. 7 figs., 6 tabs.

38423 **(DOE/NBM—7001097) Physical coal cleaning: Characterization of constituents in waste and process streams: Final report.** Junk, G.A.; Richard, J.J.; Avery, M.J.; Conzemius, R.J.; Benson, J.E.; Chriswell, C.D. (Ames Lab., IA (USA)). Dec 1986. Contract W-7405-ENG-82. 246p. (IS—4935). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87001097.

Physical cleaning of coal is employed to remove ash-forming minerals and pyrites. The cleaning increases the value of coal and simultaneously leads to a lessening of undesirable emissions when the coal is burned. However, the solid wastes and leachates of wastes arising from the cleaning of coal need to be characterized more fully and systematically. In this present work, physical coal cleaning was studied using standard sampling procedures (Section 2.0), state-of-the-art analytical techniques, and advanced procedures developed especially for this study (Section 3.0). Characterization

of organic components in wastes and leachates of wastes (Section 4.0) revealed that no harmful organic materials would be released into the environment. In fact, harmful organic components were removed from some polluted waters used in the coal cleaning process. The element composition of the wastes and leachates were determined by spark source mass spectrometry (Section 5.0) which provided a simultaneous and economical monitor of up to 75 elements. Mass spectrometric procedures developed for the study of the elements should be generally applicable to studies of elemental concentrations in all coals and coal waste. The mineral forms in the coals, coal wastes and leachates were determined using x-ray diffraction analyses (Section 6.0). These results, as well as the elemental data from spark source mass spectrometry supported the expected lowering of the mineral and elemental concentrations in the cleaned coal and the corresponding increase in these concentrations in the coal waste relative to the amounts of minerals and elements in the feed coals that were tested. 14 refs., 106, figs., 71 tabs.

38424 **Agglomeration characteristics of hydrophilic coals and pyrite/coal mixtures.** Venkatadri, R.; Markuszewski, R.; Wheelock, T.D. (Ames Lab. and Chemical Engineering Dept., Iowa State Univ., Ames, IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* 32: No. 1, 425-432(Apr 1987). (CONF-870410—). Contract W-7405-ENG-82.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The need for industry to clean fine-size coal is increasing steadily. Selective oil agglomeration of coal fines suspended in water is a practical technique for beneficiating hydrophobic coals, but the technique is less well developed for beneficiating weakly hydrophobic and hydrophilic coals such as Illinois No. 6 coal and oxidized Upper Freeport coal. The oil agglomeration characteristics of the latter were investigated in this study and compared to those of two hydrophobic materials, unoxidized Upper Freeport coal and graphite. Also, since there is a general need to improve the separation of coal particles from iron pyrite particles for all types of coal, consideration was given to this problem. In addition, the effect of sodium oleate, a well-known anionic surfactant, on the agglomeration characteristics of these materials was studied.

38425 **A study of interfacial properties in the liquid CO/sub 2/-water-coal system.** Chi, B.; Morsi, B.I.; Klinzing, G.E.; Chiang, S.H. (Chemical and Petroleum Engineering Dept., Univ. of Pittsburgh, Pittsburgh, PA 15261). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* 32: No. 1, 433-440(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

During the past few years, a great deal of interest has developed in fine coal cleaning techniques. The LICADO process relies on the relative wettability of 'clean coal and mineral particles with liquid CO/sub 2/ and water, respectively. When liquid CO/sub 2/ is dispersed into a coal-water slurry, it tends to form agglomerates with the clean coal particles and float them to the liquid CO/sub 2/ phase. The mineral particles, on the other hand, remain in the aqueous phase as refuse. Since the surface/interfacial properties of fine coal particles play such an important role in this coal cleaning operation, an understanding of their behavior becomes indispensable. Therefore, basic measurements must be made on the surface/interfacial properties of coal particles under conditions similar to those encountered in actual operation of the LICADO process.

38426 **Coal cleaning: Progress and potential.** Livengood, C.D.; Doctor, R.D. New York, NY; American Institute of Chemical Engineers (1985). 30p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract W-31-109-ENG-38.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 15B.

Results from a detailed analysis of sulfur dioxide (SO/sub 2/) reductions achievable through "deep" physical coal cleaning (PCC) at 20 coal-fired power plants in the Ohio-Indiana-Illinois region are presented in this paper. These plants all have capacities larger than 500 MWe are currently without any flue-gas-desulfurization (FGD) systems, and burn coal of greater than 1% sulfur content (in 1980). Their aggregate emissions of 2.4 million tons of SO/sub 2/ per year represents 55% of the SO/sub 2/ inventory for these states. The principal coal supplies for each power plant were identified and characterized as to coal seam and county of origin, so that published coal-washability data could be matched to each supplier. The SO/sub 2/ reductions that would result from deep cleaning and moderate cleaning of each coal were calculated using a PCC computer model.

0104 Processing

REFER ALSO TO CITATION(S) 38421, 38426, 38465, 38469, 38478, 38497, 38686, 38797, 39149, 39171, 39319

38427 **(CONF-870773—1) Biological solubilization of coal in aqueous and nonaqueous media.** Scott, C.D.; Faison, B.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011943.

From Workshop on biological treatment of coals; Washington, DC, USA (8 Jul 1987).

Current investigations into the biological solubilization of coal with microorganisms focus on the production of solubilizing activity in fungi. Test organisms for this work include a species of the yeast Candida previously isolated from a lignite outcrop, and P. chrysosporium, a filamentous higher fungus which has played a major role in lignin biodegradation research. The studies described are primarily exploratory in nature, and are fundamental to the design of more sophisticated inquiries into the physiology of fungal coal solubilization.

38428 **(CONF-8610220—4) Radical hydrogen-transfer: Rationalization of interactive effects of solvent aromaticity and hydrogen pressure on coal liquefaction.** McMillen, D.F.; Malhotra, R.; Nigenda, S.E. (SRI International, Menlo Park, CA (USA). Chemical Kinetics Dept.). Oct 1986. Contract FG22-86PC90908. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009769.

From DOE contractors meeting; Pittsburgh, PA, USA (21 Oct 1986).

This paper focuses on the use of a mechanistic model of hydrogen-transfer-induced bond scission to rationalize some interesting liquefaction and hydropyrolysis results that have recently appeared in the literature. These literature results were chosen because they relate directly to the efficiency with which hydrogen is used to produce the desired products, and because they are counter-intuitive and/or exhibit substantial changes in yield structure resulting from apparently minor changes in conditions. In the conventional view of liquefaction, inherently weak bonds in coal undergo thermolysis upon heating, and the solvent merely serves to stabilize these thermally generated radicals. The solvent is not involved in engendering bond-scission. We have previously shown that this mechanism is not consistent with the observed order of liquefaction abilities of various solvents. This inconsistency has also been recognized by some researchers. We have proposed an alternate model for coal liquefaction in which solvents mediate hydrogenolysis of strong bonds with varying degrees of effectiveness. These alternative views of coal liquefaction are depicted in the reactions given. We do not mean to imply that weak bonds do not undergo thermolysis during coal liquefaction. To the extent that there are weak bonds in the coal structure, they will undergo thermolysis; however, the critical factor that determines the efficacy of various solvent systems is their ability in bringing about H-transfer to cause cleavage of strong bonds.

38429 **(CONF-8705103—3) Corrosion-resistant scales on iron-based alloys.** Hsu, H.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011937.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Corrosion tests were conducted at 800°C on iron-based alloys in a H_2-H_2S-H_2O-Ar gas mixture with P/sub S_2/ = 10^{-6} and P/sub O_2/ = 10^{-20} atm that simulates severe coal gasification environments. Al_2O_3-forming iron-based alloys were more corrosion re-

sistant than Cr_2O_3-forming iron-based alloys in this environment. Rapid sulfidation of Al_2O_3-forming iron-based alloys with and without preoxidation proceeded initially by nucleation and growth of chromium-rich sulfides and later by formation of iron-rich sulfides. To increase the corrosion resistance of Al_2O_3-forming iron-based alloys, the formation of fast-growing sulfides, such as CrS, FeS, and sulfide mixtures containing CrS and/or FeS, should be minimized or avoided completely. A new iron-based alloy developed in this study has shown very good corrosion resistance. Only small metal sulfide particles formed on the alloy surface with no observable internal sulfidation. 6 refs., 14 figs., 3 tabs.

38430 **(CONF-8705103—8) Corrosion of alloys in mixed-gas and combustion environments.** Natesan, K. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011452.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Extensive research has been performed over the past 10 years to evaluate the compatibility of engineering materials and model alloys in oxygen-sulfur mixed-gas environments that are relevant to both coal gasification and coal combustion schemes. This paper briefly summarizes the available information to give insight into the development of protective oxide scales in high-temperature alloys exposed to complex gas atmospheres. Results from ongoing research activities on the corrosion of high-chromium alloys are used to examine the roles of several factors such as cation and sulfur transport through the scales, mechanical effects, sulfur segregation, and time-dependent morphological changes in the scale, in the onset of breakaway corrosion in structural alloys. From current knowledge of the combustion and gasification environments and of the behavior of structural alloys exposed to them, several requirements that a suitable alloy should meet are presented, and possible avenues for modification of alloys to achieve improved corrosion resistance are discussed. 31 refs., 14 figs.

38431 **(DOE/MC/20320—2355) Kinetics of high temperature and pressure char-steam reaction in coal gasification: Final report.** Yang, R.Y.K.; Lee, I.C.; Raghunathan, K.; Peng, F.F.; Jiang, W.D. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Dec 1986. Contract AC21-83MC20320. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001088.

Gasification experiments covering a wide range of temperatures (800 to 1400°C) and pressures (0 to 200 psig) were conducted at high heating rate (100 to 1000°C/sec) for the chars of three American coals, viz., an N.D. lignite, a Washington subbituminous coal and an N.M. bituminous coal, using a unique high temperature/pressure thermal gravimetric analyzer. A significant feature of this project was the gasification of the chars in steam starting directly from coals (thus termed "in-situ" chars), as opposed to a large number of previous studies in which coals were devolatilized in inert atmosphere before being gasified under totally different environments. For comparison purpose, the latter type of char, designated in this report as "non-in-situ" or "nitrogen" char, was also studied together with the "in-situ" char. For each coal, reactivity, conversion, activation energy, and other kinetic data were determined for both types of char and the results were compared, discussed and correlated. In this work, the method of using half life of reaction to unify coal gasification data was further extended to allow easy estimation of activation energy directly from half life data of the gasification reaction. Models for reactivity and conversion were also developed. In addition, microstructural properties, including specific surface area, of the "in-situ" chars at different stages of conversion, as well as the "non-in-situ" chars, were determined by gravimetric adsorption method using CO_2 at 25°C as adsorbate and the results were discussed and interpreted. The surface area data obtained were correlated and models relating surface area and conversion were also developed. 58 refs., 47 figs., 22 tabs.

38432 **(DOE/MC/21004—2285) Expansion of high-temperature high-pressure data set for coal gasification: Quarterly report, September-December 1986.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Deshpande, G.V.; Kroo, E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Dec 1986. Contract AC21-84MC21004. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87001070.

Construction of the steam pretreatment and coal pyrolysis reactors for experiments with the UCC Kentucky No. 8 coal was completed and experiments were done in both reactors. A special wire mesh reactor was developed to do pretreatment studies on thin layers of coal. In addition, a completely water-cooled electrical feed-through system was installed into the high pressure reactor (HPR) along with a new alumina test section. Data collection on the CO_2 gasification matrix continued. Nearly all of the runs with the 200 x 270 Montana Rosebud coal and more than 50% of the runs with the other size fractions (100 x 150, 325 x 400 mesh) have been completed. In general, the data trends for char recovery seem reasonable. There is some scatter in the gas yield data because of interferences in the FT-IR spectra due to the large amount of CO_2 present. In these cases, we are using GC data. Three coals were used to evaluate the effect of steam pretreatment on pyrolysis yields. For all three coals, the tar yield was found to decrease when the coals are treated with steam prior to pyrolysis. This was believed to be due to the increased solubility of hydrocarbons near the critical point of water and subsequent loss of tar during pretreatment. The fact that there was no net increase in liquid yields due to pretreatment at a pyrolysis temperature of 675°C was consistent with the work done at CUNY by Graff and Brandes. A series of N_2 surface area measurements was performed on chars produced from the Montana Rosebud coal in the HPR. There was no direct correlation of reactivity with N_2 surface area, which is the same result that has been found for chars in our other program. 4 refs., 15 figs., 3 tabs.

38433 **(DOE/MC/21046—2329) An engineering evaluation of environmental data from the Mountain Fuel Resources Coal Gasification Process Development Unit: Topical report.** Skinner, F.D.; Raden, D.P.; Castaldi, F.J.; Scheffel, F.A. (Radian Corp., Austin, TX (USA)). May 1987. Contract AC21-84MC21046. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001094.

As part of its surface coal gasification program, the US Department of Energy's Morgantown Energy Technology Center (DOE/METC) provided the major part of the funding to construct and operate a 30 ton-per-day coal gasification process development unit (PDU) gased on Mountain Fuel Resources' (MFR) entrained-bed gasification process. During November 1984, Radian Corporation conducted a sampling and analysis program at the MFR PDU under contract to DOE/METC. The purpose of this program was to characterize the hot, raw product gas and liquid and solid discharges. These data were to be used to evaluate performance and environmental aspects of the process and potential pollution control needs of a commercial-scale facility based on this process. The intent of the program was not to evaluate pollution control systems at the PDU, nor was it designed to provide comprehensive data to determine detailed material balances for the PDU. Testing was performed during MFR Test No. 50 at one process set point with relatively steady flow rates of major streams. The PDU was operating with a Utah bituminous coal during this time. The purpose of this Technology Status report is to present the results of an engineering evaluation based on the use of the data obtained during the sampling and analysis program.

38434 **(DOE/MC/21225—2267) Wet carbonization of lump-size low-rank coals by a novel non-slurry approach: Progress report for the period August-October 1986.** Lau, F.S.; Roberts, M.J.; Srivastava, V.J.; Mensinger, M.C.; Janulis, J.A.; Rue, D.M. (Institute of Gas Technology, Chicago, IL (USA)). Nov 1986. Contract AC21-84MC21225. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87005907.

Two tests were conducted in the process research unit (PRU) at nominal operating conditions of 650°F and 30 minutes residence time with North Dakota Indianhead lignite. During the

first test, the targeted operating temperature was not attained due to heat losses and the inability of the steam boiler to deliver sufficient heat to the reactor. After modifications were made to the boiler and additional insulation was installed, the second test was successfully conducted at the targeted temperature and residence time. Two hours of steady-state operation were achieved. Nine successful tests were conducted in the free-fall devolatilization reactor with raw and wet-carbonized low-rank coals. The tests were conducted at a temperature and pressure of 1300°F and 500 psig, respectively, with a steam-hydrogen mixture (50 mol % hydrogen). About 150 grams of coal were fed during the 60-minute duration of the tests. The product solid, liquid, and gas samples are being analyzed. Also, one successful thermobalance test was conducted with coal that had been wet-carbonized in the PRU at 650°F with a residence time of 30 minutes. Anaerobic digestion tests continued with filtered product water from the batch wet carbonization unit and the PRU. The objective of these tests is to determine the preferred reactor configuration and operating conditions for producing methane from and reducing the chemical oxygen demand of the wet-carbonization product water.

38435 **(DOE/MC/22146—2309) KILnGAS RAM [Reliability, Availability, and Maintainability] IIA summary test report.** (Allis-Chalmers Coal Gas Corp., Milwaukee, WI (USA)). Apr 1987. Contract FC21-85MC22146. 245p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87001086.

This report summarizes the findings and results of the KILnGAS Commercial Module RAM IIA (Reliability, Availability, and Maintainability) test operation, which was the culmination of the RAM IIA program. The RAM IIA program was performed by the Allis-Chalmers Coal Gas Corporation during the fourth quarter of 1986. Funding was provided by the Federal Department of Energy, the State of Illinois and the utility companies listed in the report. The KILnGAS Commercial Module (KCM) is a 600-ton-per-day gasification demonstration plant located on the site of the Illinois Power Company Wood River Generating Station in East Alton, Illinois. The plant was commissioned in 1983, and initial demonstration testing was conducted in 1984. The RAM program was initiated in 1985 and the first phase of the program (RAM I) was concluded in April 1986. Descriptions of the KILnGAS process and the KILnGAS Commercial Module, and of the overall KILnGAS program appear in numerous public documents, and specifically in the "Program Plan for KILnGAS RAM IIA," prepared for the US Department of Energy. RAM I focused primarily on the introduction of performance-oriented plant improvements, followed by testing to evaluate their effectiveness. By comparison, RAM IIA focused on several areas including plant availability and performance improvements, and on formalizing data acquisition on plant reliability, availability, and maintainability. RAM IIA testing began with plant startup on October 13, and was concluded with the initiation of plant shutdown activities on December 21, 1986. The test approach is described in the "Test Plan for KILnGAS RAM IIA," issued on September 26, 1986. The KCM flow diagram for the RAM IIA test is presented in Appendix C to this document. 16 figs., 10 tabs.

38436 **(DOE/MC/23057—2273) Novel concept development of an internal recirculation catalyst for mild gasification: Progress report for the period September 1-November 30, 1986.** Solka, B.; Anderson, G.L.; Feldkirchner, H.L.; Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1987. Contract AC21-86MC23057. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006033.

The goal of this program is to evaluate a novel process concept for mild gasification of coal using an internal recirculating catalyst. This report describes progress during the first quarter of the program. The work is divided into three major tasks: laboratory-scale tests, bench-scale tests, and proof-of-concept tests and evaluation. The objectives of the individual tasks are described: The objective of the laboratory-scale tests is to obtain detailed information on the effects of the selected internal recirculation catalyst, CsOH, on the products of mild coal gasification using a pyrolysis-gas chromatographic mass spectrometry system. Three different types of coals (Illinois No. 6 coal, Wyodak subbituminous coal, and North Dakota lignite) are to be tested; the effect of operating conditions on product quality will be investigated. The objective of the bench-scale tests is to conduct larger scale tests (than those of Task 1) on the effects of the CsOH catalyst on the products of mild coal gasification. These tests will be conducted with the three selected test coals in a nominal 2-inch-ID fluidized-bed gasifier. The objective of the proof-of-concept tests and evaluation, which is subject to the approval of DOE/METC to proceed, is to conduct large-scale testing of the effect of the internal recirculation catalyst on mild coal gasification and process design and economic studies. These large-scale tests are to be conducted in an existing 8-inch-diameter gasifier.

38437 **(DOE/PC/70786—T10) Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 12/1/86-2/28/87.** Eisch, J.J. (State Univ. of New York, Binghamton (USA)). 1 Apr 1987. Contract FG22-84PC70786. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012710.

During the tenth quarter of this three-year grant the following aspects of this study were pursued: (1) the homogeneous, nickel(0)-catalyzed disproportionation of dihydroaromatics into aromatics and tetrahydroaromatics was investigated for the cases of dihydrobenzenes(1,2- and 1,4), dihydronaphthalenes (1,2- and 1,4), 9,10-dihydroanthracene, 9,10-dihydrophenanthrene and 4,5-dihydropyrene; (2) the hydrogen shuttling between different aromatic dihydro donors and aromatic acceptors was examined under attempted nickel(0)- and Lewis acid-catalysis; (3) the hydrogen transfer between dihydroazaaromatic systems and Schiff bases, as exemplified by the reaction between 1,2-dihydroquinolines and benzalaniline, was found to be acid-catalyzed; (4) the nickel(0)-catalyzed cleavage of carbon-carbon bonds was explored with 1,2,3-triphenylcyclopropene, phenylated ethanes, diphenylcyclobutenes and related systems; and (5) the synergistic catalysis of nickel(0) and Lewis acids on intermolecular hydrogen transfer was put to the test. The outstanding finding is that hydrogen transfer is subject to both nickel(0) catalysis and Lewis acid catalysis by organoaluminum compounds, such as methylaluminum chlorides. In fact, the combined use of both nickel(0) and methylaluminum chloride gives a synergistic catalysis to the transfer of hydrogen between 9,10-dihydroanthracene and diphenylethenes, such as 1,1-diphenylethene and trans-1,2-diphenylethene. This finding encourages us to test whether we can catalyze the conversion of Ar-CH==CH-Ar systems into carbon-bond cleaved fragments, Ar-CH_3. Such a process would aid the liquefaction of coals at lower temperatures.

38438 **(DOE/PC/80523—T7) Surface and electrochemical studies in coal cleaning: Technical progress report, April 1, 1987-June 30, 1987.** Chander, S.; Aplan, F.F. (Pennsylvania State Univ., University Park (USA)). 1987. Contract FG22-85PC80523. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012727.

This project is concerned with the development of better ways to remove harmful constituents (sulfur, ash-forming minerals) from coal prior to combustion. Objectives are to characterize the coal, ash-forming and sulfur-forming minerals in coal and to develop an electrochemical flotation method to clean coal.

38439 **(DOE/PC/80541—T7) A study of some wastewater contaminants: Seventh quarterly report for the period March 17, 1986 through June 15, 1987.** Wilson, R.F. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1987. Contract FG22-85PC80541. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011984.

Polarographic studies on the individual ions, viz., $Cr_2O_7^{2-}$, Fe^{+3}, Cu^{+2}, Zn^{+2}, Co^{+2} and UO_2^{+2} have been carried out in several selected buffers. These data show that it was facilitating to select a composite model compound, viz., 2-Hydroxymethyl-6(2'-hydrozymethyl-5'-hydrozy-4'pyrone-6')pyranyl-[3,2-b]pyran-4,8-dione to study first as a phenol like substance with the view of transferring the knowledge gained to the study of phenols obtained from process wastewater contaminants. The interaction of iron(III), copper(II), zinc(II), cobalt(II) dichromate ion, and dioxouranium(VI) ion with our model reagent has been studied in some detail. The formation constants and coordination numbers for most of these ions have been determined using the polarograph. After carrying out elemental and polarographic analyses using numerous buffers and/or supporting electrolytes, potassium nitrate

was generally selected as the best buffer for avoiding competing complex ion formation between the selected metal ion and the phenolic compound. These experimental data show that iron(III), dichromate ion, and dioxouranium(VI) ion form a 2 to 1 complex and copper(II), cobalt(II) and zinc(II) each forms 1 to 1 complex with the model chelating reagents. Recently we have isolated the coordination compounds of the aforementioned complex ions by precipitation, extraction, and salting out. Optimum conditions for isolating these species have been carried out. These solids are being analyzed to ascertain their bonding characteristics, etc. More recently, we have begun a systematic polarographic study of process wastewater phenolic compounds. These studies include a study mono and polyhydroxy phenols. Infrared spectra are being obtained for the purpose of determining the bonding characteristics in these compounds.

38440 **(FRNC-TH—2351) Coal hydroliquefaction under pressure in presence of iron based catalysts.** Andres-Besson, M. (Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 216p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752662.

Iron based catalysts are studied for liquefaction of coal in suspension in recycled process oil under a hydrogen pressure of 20 MPa at 723 K, the aim is low production of high boiling point products. Catalytic activity and physico-chemical properties of studied solids are examined. Reaction mechanisms are studied in model reactors.

38441 **(PB—87-175014/XAB) Conditioning coal gas with refrigerated methanol in a system of packed columns.** Rousseau, R.W.; Ferrell, J.K.; Kelly, R.M. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). 1985. 11p. NTIS, PC A02/MF A01.

Pub. in Chemical Engineering Communications, Vol. 34, 27-35(1985).

The paper discusses potential difficulties in the operation of acid-gas-removal systems for gases produced from coal, based on experience with pilot-scale unit operation. The pilot plant was used to condition gases produced from subbituminous coal, devolatilized char, peat, and lignite. The solvent used in the acid-gas-removal system was refrigerated methyl alcohol. Data from this study document accumulation of hydrocarbons, sulfur and nitrogen compounds, and mercury in the circulating solvent.

38442 **(PB—87-182689/XAB) Development of a data base characterizing US coal reserves by their sulfur-reduction potential through physical coal cleaning. Final report, May 1985-October 1986.** Minnucci, C.; Resnick, B.S.; Herhal, A.J.; Jones, J.W. (Science Applications International Corp., Norristown, PA (USA)). Apr 1987. 19p. NTIS, PC A02/MF A01.

The paper describes a data base that merges the U.S. Demonstrated Reserve Base (DRB) with estimates of the SO_2 reduction attainable through physical coal cleaning of the DRB coals. The DRB is subdivided into roughly 38,000 separate reserve blocks, each of which is characterized as to its raw quality and SO_2 reduction potential under various physical coal-cleaning scenarios. The methodology and data sources used in developing the database are presented. The paper focuses on the coal-cleaning model used to develop the SO_2 reduction and the methodology used to merge these estimates with the DRB. State-level potential SO_2 reduction and cost estimates obtained by processing the data base are presented.

38443 **(UCRL—94418) Experimental investigation of coal spalling.** Upadhye, R.S.; Field, J.E.; Fields, D.B.; Britten, J.A.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 10p. (CONF-860822—2). NTIS, PC A02. File Number DE87011882.

From 12. annual symposium on underground coal gasification; Saarbrucken, F.R. Germany (25 Aug 1986).

The concept of roof spalling has been widely used to develop models of underground coal gasification (UCG) phenomena. Under this concept, dried and pyrolyzed coal at the cavity roof weakens, leading to a steady shower of small pieces of char, which are then gasified in a rubble bed by reactive gases such as oxygen and steam. To explain the assumed spalling, various mechanisms have been invoked, including thermal stresses in the coal/char. However, a mechanistic demonstration of coal spalling has hitherto not been made. The purpose of this paper is to present a limited experimental investigation of the coal spalling concept. We heated cylinder blocks (nominal size 7″ diameter, 5″ height) of sub-bituminous coals to temperatures expected in UCG cavities (about 700 C) using a steady stream of hot (about 800 C) inert gas for various periods of time in an apparatus designed for this purpose. We present and discuss the results of these experiments. We conclude, on the basis of these experiments, the spalling does not occur on the scale of these experiments for western coals. 7 refs., 3 figs., 3 tabs.

38444 **(UCRL—94419) A mechanistic model for axisymmetric UCG [underground coal gasification] cavity growth.** Thorsness, C.B.; Britten, J.A. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 15p. (CONF-860822—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011570.

From 12. annual symposium on underground coal gasification; Saarbrucken, F.R. Germany (25 Aug 1986).

A three-dimensional, axisymmetric model to describe cavity growth during underground coal gasification (UCG) has been developed. The model makes use of a few basic assumptions concerning dominant heat and mass transfer processes in various zones of the cavity, and employs no arbitrary parameters of significant impact. Other features of the model include the capability to follow the evolution of the cavity from near start-up to exhaustion, and explicit coupling of wall and roof surface growth mechanisms. The model assumes that the cavity consists of up to three distinct rubble regions and a void space. Resistance to injected gas flow from a point low in the coal seam is assumed to be concentrated in the ash pile surrounding this point. A zone of relatively higher permeability is assumed to exist at the ash/coal wall interface, and rock and char rubble flow resistances are assumed negligible. Flow of injected gas through the ash is coupled by material and energy balances to cavity growth at the rubble/coal, void/coal and void/rock interfaces using previously developed submodels. The model is capable of simulating a wide range of coal and overburden compositions and stratigraphy, as well as water influx. In this paper, the model is described, the method of solution of the model equations is outlined, and the results of preliminary simulations are discussed. 9 refs.

38445 **(UCRL—94422) Review of the CRIP [Controlled Retracting Injection Point] process.** Hill, R.W. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 14p. (CONF-860822—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011572.

From 12. annual symposium on underground coal gasification; Saarbrucken, F.R. Germany (25 Aug 1986).

The Lawrence Livermore National Laboratory has been working in the field of underground coal gasification since 1976. We have had a balanced program of modeling, laboratory experiments and field experiments. We have developed several cavity growth and gas composition models. These are designed to be as simple and modular as possible because of the lack of detailed input information and the need to keep cooputing time low. Our laboratory program is designed to complement and support the modeling effort and the field program. We conducted three field tests at Hoe Creek, Wyoming; each one using a different linking method. We did a series of five small field tests at Centralia, Washington, to study burn cavity development as a function of injection parameters. These were followed a year later by a larger test of the Controlled Retracting Injection Point, or CRIP, process. This concept is used in the design of the Belgian-German test and in the coming Rocky Mountain-1 test. It utilizes injection through a horizontal drilled hole to hold the injection point on the bottom of the seam and a controlled destruction of the injection pipe to move the burn zone when the product gas quality deteriorates. 16 refs., 12 figs.

38446 The chemical basis for removal of organic sulfur from coal via JPL chlorinolysis. Aida, T.; Venier, C.G.; Squires, T.G. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 486-491(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Because of the environmental problems attributable to Acid Rain, sulfur removal has been one of the most important areas of coal utilization research. Although a number of physical and chemical desulfurization processes which effectively remove inorganic sulfur have been developed, only a small portion of the organic sulfur can be removed under these conditions. The authors have investigated the behavior of various organic sulfur functional groups under JPL Chlorinolysis conditions in order to elucidate the major desulfurization pathways. They have also looked at undesirable chlorination side reactions and have briefly examined conditions which minimize the ratio of chlorination to desulfurization.

38447 A new method for estimation of activation energies associated with coal gasification reactions. Raghunathan, K.; Yang, R.Y.K. (Dept. of Chemical Engineering, West Virginia Univ., Morgantown, WV 26506-6101). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 478-485(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Kinetic studies of coal gasification and pyrolysis are important in the design and operation of gasification plants. In many of these studies, weight loss of a coal sample is continuously recorded, with a TGA for example, to produce conversion versus time data for a specific set of experimental conditions. Theoretical and empirical models are frequently used to represent those primary kinetic data. With a proper representation of the conversion data, other secondary kinetic data such as half-life and reactivity are evaluated. Characterization of coal, development of proper reaction rate models and estimation of its activation energy follow. In this work the authors use the unification approach as the basis to develop an theoretical relation between half-life and average reactivity which is then verified experimentally. The relation in turn leads to the development of a simple and practical alternative for estimating the apparent activation energies of coal gasification and other types of reactions.

38448 Preparation and reactivity of latexes from low-rank coals. Olson, E.S.; Diehl, J.W.; Froehlich, M.L. (Univ. of North Dakota Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 94-97(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

This paper describes the investigations of the conversion of low-rank coals into a stable dispersed form which exhibits altered reactivities toward various alkylating, reducing, and oxidizing reagents. This stable dispersion of a solid in a liquid medium is properly called a latex. The objective of this study was to study the conversion of low-rank coals to humic acids under conditions of high mass flow (under nitrogen) and to investigate the nature of the humate material with regard to solubility and reactivity. The effects of coal type, nature of the base, and added surfactant on the conversion were studied.

38449 Dry catalytic liquefaction of a subbituminous coal: Structural inferences. Derbyshire, F.J.; Terrer, M.T.; Davis, A.; Lin, R. (College of Earth and Mineral Sciences, The Pennsylvania State Univ., University Park, PA 16802). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 98-106(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The catalytic liquefaction of a subbituminous coal has been studied in the absence of solvent using an impregnated sulfided Mo catalyst. Reactions were conducted for various times at temperatures from 300-400°C. The yield and composition of gaseous products, chloroform-soluble liquids and insoluble residue were followed as a function of the reaction conditions, using a number of techniques. Associated changes in the structure and composition of the chloroform-insoluble residue have been further investigated by petrographic analysis and by measurements of swelling in pyridine. The implications are that a large proportion of the coal network structure involves hydrogen-bonded cross linkages.

38450 Elucidation of chemical processes in coal liquefaction: Effect of radical quenchers. Aida, T.; Slomka, B.; Squires, T.G. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 589-597(Apr 1987). (CONF-870410—). Contract W-7405-ENG-82.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The thermal liquefaction of coal is a complex, heterogeneous process involving two mutually interactive phenomena: chemical transformation of the organic material and mass transfer between solid, liquid, an gaseous phases. Thermally generated free radicals play a key role in these conversions; and their subsequent interactions with other species, e.g. hydrogen donors, determine the course of the liquefaction process and the final product mixture. In the present study, the authors investigate the effects of radical quenchers, radical initiators, and chain transfer agents on the thermal solubilization of pyridine extracted Illinois No.6 coal in benzene.

38451 Catalyzed coal conversion using water or alcohols. Bockrath, B.C.; Davis, H.M. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 598-603(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Water and some alcohols such as 1-octanol have certain properties that can be used to good advantage in coal liquefaction. Topics considered in this paper include catalysts, chemical reaction kinetics, solvent properties, and catalytic effects.

38452 "New fuels" via direct coal liquefaction. Moroni, E.C. (U.S. Dept. of Energy, FE-34 GTN, Washington, DC 20545). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 611-616(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

This paper is part of a series of papers directed to inform the research community of the major achievements obtained during the development of the Integrated Two-Stage Liquefaction (ITSL) process and recent results from a few research laboratories which are closely related to the ITSL approach. The conclusion derived from these achievements is that the low-severity approach, exemplified by the ITSL process, has shaped a new direction in direct coal liquefaction development which needs further complementary support work of manifestly fundamental nature. This paper intends to demonstrate that low-severity coal liquefaction operations are instrumental in producing some uniquely structured hydrocarbon distillate products. While the structure of these hydrocarbons can be traced to the unique condensed cyclic hydrocarbon structure present in coals, the low-severity operations, practiced in staged coal liquefaction processes, are the main contributors to the maintenance of the cyclic structure throughout and up to the final distillate products.

38453 Catalytic hydrocracking of tar vapours in hydropyrolysis. Bolton, C.; Snape, C.E.; Stephens, H.P. (British Coal, Coal Research Establishment, Stoke Orchard, Cheltenham, Glos., GL52 4RZ). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 617-627(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Tar vapours have been hydrotreated in the second stage of a fixed-bed two-stage hydropyrolysis reactor using hydrous titanium oxide catalysts exchanged with Ni, Co, Mo and Pd and a commer-

cially available Ni/Mo on alumina catalyst. The primary tar, which accounted for 25-30% daf coal (UK bituminous, 82% dmmf C) was converted at 400°C and 150 bar to a colourless liquid low in heteroatoms of which up to 40% boiled below 150°C. The gas yield was only slightly higher than that obtained in corresponding single-stage tests. A lower boiling product was obtained with Ni/Co/Mo hydrous titanium oxide than with the commercial Ni/Mo catalyst.

38454 **Role of iron vacancies in pyrrhotite-catalyzed liquefaction using H/sub 2/S and CO.** Nowok, J.; Stenberg, V.I. (Dept. of Chemistry, Univ. of North Dakota, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 628-636(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

As a part of continuing investigations into the chemistry of liquefaction catalyzed by metal sulfides, a study was made of the interaction of H/sub 2/S and CO with the pyrrhotite surface using ESR spectroscopy. Mineral contained in coals are reported to promote hydrogenation and hydrodesulfurization in low-rank coal conversion processes. More specifically, those containing iron are found to promote both hydrogenation and desulfurization reactions. In the pyrite and pyrrhotite forms, iron has hydrogenation activity. The liquefaction activities of iron sulfides in the absence of added H/sub 2/S are distinguished by sulfur concentration and shown to be FeS/sub 2/ > Fe/sub 2/S/sub 3/ > Fe/sub 1-x/S > FeS.

38455 **Effect of temperature programming on the liquefaction of Indianhead lignite in an inorganic (H/sub 2/S-H/sub 2/O) solvent system.** Sweeny, P.G.; Gutenkunst, V.; Martin-Schwan, M.E.; Stenberg, V.I. (Dept. of Chemistry, The Univ. of North Dakota, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 637-642(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

High conversions can now be achieved using lower reactor temperatures and a temperature programming technique. Various temperature programs using times between 7.5 and 60 minutes and temperatures from 300° to 480°C were used to liquefy Indianhead lignite. The inorganic solvent system H/sub 2/S-H/sub 2/O was used in conjunction with CO, H/sub 2/ and pyrrhotite as the liquefaction media. Programming the temperature produced higher THF soluble and cyclohexane soluble yields than the use of isothermal temperatures.

38456 **Chemical fate of basic nitrogen components in a coal liquefaction study.** Hellgeth, J.W.; Amateis, P.G.; Taylor, L.T. (Dept. of Chemistry, Virginia Polytechnic Institute and State Univ., Blacksburg, VA). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 768-773(Apr 1987).

The fate of basic nitrogen heterocycles as components in direct liquefaction has been investigated through the analysis of process-derived materials with advanced analytical methods. Products were obtained from a batch liquefaction of Wyodak No. 3 subbituminous coal with 1,2,3,4-tetrahydroquinoline (THQ) under reaction conditions of 2:1 solvent:coal, 785°F reaction temperature, 30-min reaction time, and 1100 psig cold charge hydrogen pressure. IR spectra of chromatographic peak components implied the presence of pyridonic nitrogen components and dimeric THQ derivatives. The presence of these species was confirmed by FIMS analysis.

38457 **Studies of catalyst samples from a two-stage direct coal liquefaction run.** Stohl, F.V.; Qader, Q.A.; Massoth, F.E.; Thakur, D.S. (Sandia National Labs., Organization 6254, Albuquerque, NM 87185). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 840-845(Apr 1987). Contract AC04-76DP00789.

Catalysts from the hydrotreating stage of a two-stage direct coal liquefaction run were characterized, and their residual catalytic activities for several functionalities were evaluated with model compounds. The catalyst samples, from each of two hydrotreating reactors in series, showed greater than 80% activity losses for all functionalities. Less carbonaceous deposits were present in the first reactor catalyst as compared to the second reactor catalyst, whereas the reverse was true for contaminant metal deposits, which were concentrated near the catalyst particles' exterior. Both carbonaceous and contaminant metal deposits caused deactivation due to covering of active sites.

0105 By-products

REFER ALSO TO CITATION(S) 38448

0106 Properties

REFER ALSO TO CITATION(S) 38423, 38424, 38425, 38447, 39325

38458 **(CONF-870410—32) The eight coals in the Argonne Premium Coal Sample Program.** Vorres, K.S.; Janikowski, S.K. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011529.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The full set of eight coals for the Premium Coal Sample Program includes a lignite, subbituminous, high volatile, medium volatile and low volatile bituminous, as well as a resinite rich and inertinite rich and Pittsburgh No. 8 coking coal. The coals were selected on the basis of C, H, S, and O content as well as maceral content and geological age. Ampoules are typically available in 5 grams of -100 mesh or 10 grams of -20 mesh material. Some analytical information is available. The methods of selection, collection, transportation, processing, packaging, distribution and characterization are summarized.

38459 **(DGMK—289-07) Literature review with respect to the application of standard thermal analysis methods on coal and its related products.** Kettrup, A.; Ohrbach, K.H. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.); Paderborn Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik). Sep 1986. 159p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-08680.

A number of 217 publications dealing with the application of thermal analysis techniques on coal and coal products have been summarized in German language and organized in product specific groups. The experiments have been carried out applying nearly all TA-methods including modern, simultaneously working coupling techniques. The experimental conditions varied according to the given objectives of the papers. With 217 refs.

38460 **(DOE/PC/80911—T6) Linkages and aromatic clusters in a bituminous coal: Quarterly technical progress report No. 6 for the period 12/1/86 through 2/28/87.** Chung, K.E. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). 1987. Contract FG22-85PC80911. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012157.

The objectives of this investigation are: (1) quantitative characterization of a bituminous coal in terms of its major composition and molecular structural characteristics; and (2) a specific examination of aliphatic linkages of the coal. The characterization methodology consists of a controlled depolymerization of a sample coal, solvent extraction of the product, and detailed analysis of the product fractions. An Illinois No. 6 coal was solubilized in reactions with NaOH/ethanol/H_2O at 260, 300 and 320°C, which are called Ill-260, Ill-300 and Ill-320, respectively. Major results previously presented from Ill-260 and Ill-300 include the distribution and arrangement of aromatic clusters, linkages, side chains and oxygen functional groups in the coal. Based on these structural data, a molecular structural model of the Illinois coal was concentrated, and product distribution and a minimum hydrogen requirement in the hydroliquefaction of the coal were predicted. During the solubilization reactions, ether groups of the coal were hydrolyzed, resulting in soluble products which have higher H/C ratio than the coal. In Ill-320, the molecular size and aromaticity of product fractions decreased significantly, compared with those of Ill-300 fractions, but the aromatic cluster size increased. The structural data and large in-

crease in CO_2 yield indicate that phenol rings in aromatic clusters were hydrolyzed and opened extensively leading to the cleavage of linkages, while some aromatic clusters fused together. This observation reveals that the strong linkages of the coal are reactive at substantially lower temperatures than the current hydroliquefaction temperatures, 370 to 430°C. Transalkylation reactions of two product fractions from Ill-300 were carried out using toluene as a acceptor and trifluoromethanesulphonic acid as a catalyst. 2 refs., 3 figs., 2 tabs.

38461 **(DOE/PC/90520—3) Structural environment of metallic constituents in coals: Quarterly report, 16 April 1987-15 July 1987.** Bauer, S.H.; Huffman G.P. (Cornell Univ., Ithaca, NY (USA). Baker Lab.; Kentucky Univ., Lexington (USA). Consortium for Fossil Fuel Science). 20 Jul 1987. Contract FG22-86PC90520. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012548.

At the University of Kentucky, work continues on the analysis of coals which incorporate the low atomic number elements, sulfur and chlorine, using x-ray absorption spectroscopic techniques. Significant progress has been made to date regarding the form(s) of their occurrence. We anticipate that these findings may have significant repercussions in the coal science community. During the current quarter 25 S and C1 containing samples were investigated at the Stanford Synchrotron Radiation Laboratory (SSRL). While these included some new coal and coal-related materials, for the most part additional standard compounds were studied because we considered this essential in view of our experimental findings in January. Most of the effort this quarter was directed towards analyzing these data and in further refining the data obtained previously. At Cornell XANES and EXAFS spectra at the Ti K-edge were recorded at the CHESS facility, of feed coal, and of coal liquefaction stream materials, as well as of various "calibrating" crystalline materials of known structure. Whereas analysis of these data is still incomplete, preliminary results indicate that, except for the coal and possibly the spent catalyst in which anatase appears to be present, inorganic titanium oxides are not present in the liquefaction stream materials.

38462 **(DOE/PC/90534—5) Supercritical fluid chromatography/supersonic jet spectroscopy: Progress report, 3/16/87-6/1/87.** Goates, S.R.; Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90534. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012717.

We have struggled this past quarter with sensitivity, but improvements in the mount for the fluorescence deflection mirror seems to have gotten us back on track. Additionally, focusing the excitation beam onto the jet with a one meter lens has improved the signal, both by increasing excitation intensity at the focal point and by allowing the beam to be brought closer to the jet nozzle. These observations were made with direct expansions through small pinhole nozzles; we may find that a broader beam or a cylindrically focused beam will be better suited to some of the other nozzle arrangements we are investigating, where supersonic flow may develop farther away from the nozzle. However, one of the primary benefits of focusing the beam was to drastically reduce stray light scattering off the nozzle. Stray light has continued to be a major limitation despite the light baffles we employ in the excitation beam path. For further experiments with the unfocused beam we plan to use a telescope with spatial filter to clean up the beam fringes. We continue to improve the automation and computer control of our equipment, and while we are still delayed with the implementation of the array detector, programming routines for signal processing are nearly complete. Automation of temperature control of the thermal interface from chromatograph to vacuum chamber has also been done. Laser-induced fluorescence (LIF) detection has been our method of choice as we work to solve many of the problems associated with coupling supersonic jet spectroscopy to supercritical fluid chromatography, but a major goal of this work is to pursue other spectroscopic detection methods.

38463 **(DOE/PC/90957—T3) Fluidization mechanisms in slurry flows: Quarterly report.** Campbell, C.S. (University of Southern California, Los Angeles (USA). Dept. of Mechanical Engineering). Jul 1987. Contract FG22-86PC90957. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012667.

The major goal of this project is to determine by which mechanism, nonbuoyant solid particles are held in suspension in a slurry flow. Basically, this is accomplished either by: (1) entrainment of particles in turbulent eddies or (2) self-fluidization of the particles by Bagnold dispersive stresses, in much the same way as in a dry granular material. The principal object is to determine what percentage of each mechanism is active at any given time as a function of particle size, velocity and particle concentration. The technique by which this is determined uses special pressure transducers that can independently determine what fraction of the total pressure is exerted by the fluid and which portion is exerted by the impacts of particles. (These latter are the Bagnold dispersive stresses.) The weight of particles per unit channel length are found from densitometry techniques. The percentage of this weight that is reflected in the net particle pressure is that fraction supported by the Bagnold dispersive stresses. The rest must then be supported by entrainment in turbulent eddies. Work has been progressing on the development of the particle pressure probes, which are now in their third iteration. Along these lines, we have also been continuing testing the probes by performing particle pressure measurements in a gas-fluidized bed. Also used in these experiments is a small gamma ray densitometer, that will eventually be transferred to the slurry loop to use for the bulk density measurements.

38464 **(DOE/PC/90960—4) Rheology of high concentration polymodal multiphase flow: Quarterly report.** Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1987. Contract FG22-86PC90960. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012408.

As described in earlier progress reports the basis of the theoretical analysis for the determination of the viscosity of polydisperse pulverized coal slurry is to consider the slurry as made up of two relatively distinct particle fractions - a coarse fraction and a smaller fine fraction. The particles in the fine fraction are of micron size and are assumed to behave colloidally, "stiffening" the liquid and giving the liquid its rheological properties. The coarse fraction, which takes up most of the space, "sees" the stiffened non-Newtonian liquid and raises the viscosity through hydrodynamic dissipation associated with the relative motions of the coarse particles in the "stiffened" liquid. To evaluate the theoretical model for concentrated polymodal coal-water slurries, a series of measurements were carried out that were capable of separately specifying the contribution of the colloidal and coarse particles to the viscosity as a function of shear rate. Experiments were run with coal particles, using different size colloidal particles ($<5\mu m$) and different size coarse particles (100 μm to 200 μm). 4 figs.

38465 **On-line, real-time alkali monitor for process stream analysis.** Hensel, J.P.; Goff, D.R.; Logan, R.G.; Pineault, R.; Romanosky R.R. Jr.; Wachter, J.K. (Morgantown Energy Technology Center, U. S. Department of Energy, Morgantown, West Virginia 26505). *Review of Scientific Instruments;* **58**: No. 9, 1647-1654(Sep 1987).

In order to acquire real-time transient alkali data on coal-derived gaseous fuel and combustion streams often at low ppb levels, an extractive, total (vapor and particle-bound) sodium and potassium monitor has been designed, constructed, and tested. This fiber-optic alkali monitor (FOAM) utilizes state-of-the-art fiber-optic light transfer, a novel light-filtering background correction method, and high sensitivity photodiode signal detection. The sample enters the monitor's high-temperature flame, which supplies energy to both decompose and excite the sample. The flame then emits light at the characteristic wavelengths of sodium and potassium. The resulting emissions are transferred by the fiber-optic bundle to the detection system, where the signal is filtered, background corrected, and transferred to the data system. The FOAM has advantages over previous instrumentation in being rugged, portable, and compact. Laboratory testing of the FOAM has been completed. The FOAM was determined to be highly sensitive (mid-ppt detection

limits) with a wide linear dynamic range (four orders of magnitude). The results of field monitoring of alkali levels in the exhaust stream of a pressurized combustor using the FOAM indicated that the monitor was capable of real-time, fast tracking of transient alkali behavior in a high-temperature/high-pressure process stream.

38466 **Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin.** Hayatsu, R.; Botto, R.E.; Mc Beth, R.L.; Scott, R.G.; Winans, R.E. (Chemistry Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 1-8(Apr 1987). (CONF-870410—). Contract W-31-109-ENG-38.

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The maceral sporinite is thought to be derived from spores and pollen. Both sporinite and sporopollenin, the insoluble cell wall residue after chemical treatment, are considered to have a highly polymerized, cross-linked aliphatic structure with some aromatics. Many investigators have endeavored to characterize the physical and chemical nature of sporinites and sporopollenin; however, their chemical structures have not been well defined. Furthermore, little is known about how sporopollenin transforms to sporinites during the early stage of coalification. The aim of the present study is to compare chemical structures of an immature sporinite and its precursor, sporopollenin. In a parallel experiment, the transformation of sporopollenin into a synthetic sporinite has been carried out in the laboratory using thermal catalytic reactions under conditions of simulated catagenetic maturation.

38467 **Quantitative analysis of coal and coal components by scanning electron microscopy and electron microprobe analysis.** Karner, F.R.; Schobert, H.H.; Zygarlicke, C.J.; Hoff, J.L.; Huber, T.P. (Univ. of North Dakota Energy Research Center, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 49-61(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Quantitative compositional data for coal typically consists of bulk chemical data for organic elements and analyses of the inorganic elements in ash. This paper focuses on bringing together procedures primarily using scanning electron microscopy (SEM) and electron microprobe analysis (EMPA) to obtain the inorganic element content of bulk coal samples; the inorganic element content of specific lithotypes and macerals in coal; the abundance of macerals in coal (using standard petrographic techniques); the inorganic element content of specific mineral phases in coal; and the abundance of mineral phases in coal. SEM/EMPA techniques allow both inorganic analysis of bulk materials and determination of chemistry and abundance of microscopic constituents. This approach provides data on individual components.

38468 **Characterization of mineral matter in sub-bituminous coals by AIA-SEM.** Straszheim, W.E.; Yousling, J.G.; Younkin, K.A.; Markuszewski, R. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 62-69(Apr 1987). (CONF-870410—). Contract W-7405-ENG-82.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Automated image analysis (AIA) was used with scanning electron microscopy (SEM) and energy-dispersive x-ray spectroscopy to characterize the mineral matter in two western sub-bituminous coals from the Adaville No. 11 seam (Kemmerer, WY) and the Dietz No. 1 and 2 seams (Decker, MT). The samples were ground to -200 mesh and cleaned by float-sink separation at 1.40 and 1.38 sp. gr., respectively. The particles were characterized before and after cleaning for mineral phase and size distribution by classifying them into 6 sizes and 16 mineral categories. Quartz was the dominant mineral in both coals, with the Adaville sample containing primarily quartz and an iron-rich mineral.

38469 **The role of heat of immersion calorimetry and gas adsorption in determining the surface areas of a thermally treated lignite and supercritically solvent extracted low-rank coal residues.** Tye, C.; Maas, D.J.; Swanson, M.L. (Univ. of North Dakota, Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 70-81(Apr 1987). (CONF-870410—). Contract FC21-83FE60181.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Comparative surface area data can be obtained from the exothermic heat liberated when a solid substance is immersed in a suitable liquid penetrant. The surface areas determined by this method provide an explanation of results of thermal treatment and supercritical solvent extraction of low-rank coal. The thermally treated samples were prepared by drying Indian Head (North Dakota) lignite at 330°C with hot nitrogen gas at atmospheric pressure or with hot water under pressure. Lignite and subbituminous coal samples were also supercritically solvent extracted in a semi-continuous extraction system at temperatures of 250° to 380°C and reduced pressures between 1.05 and 2.00 in methanol, benzene, and cyclohexane. These samples were tested in a specially constructed heat of immersion calorimeter.

38470 **Investigations of anodically oxidised coal.** Lalvani, S.B. (Dept. of Mechanical Engineering and Energy Processes, Southern Illinois Univ. - Carbondale, Carbondale, IL 62901). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 107-117(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

This paper reports more details as to products formed during coal electrolysis in basic media and considers various possible reaction pathways for electrochemical oxidation of coal. Constant potentials were employed in this work and the reaction products were analysed by FTIR, and for elemental compositions.

38471 **The role of aliphatic and aromatic coal structures and macerals in low temperature oxidation processes.** Yun, Y.; Jakab, E.; Mc Clennen, W.H.; Hill, G.R.; Meuzelaar, H.L.C. (Biomaterials Profiling Center, Univ. of Utah, Salt Lake City, UT 84108). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 129-137(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Low temperature ($\leqq$ 100°C) coal oxidation processes are known to have a pronounced effect on important coal properties such as coking and caking behavior, heat of combustion, floatability, slurry pH, tar yield and extractability. However, the mechanisms and kinetics of the chemical reactions underlying such "weathering" processes in coals are far from well understood. Among the most promising analytical methods for elucidating the structural and compositional changes during coal weathering are Fourier Transform infrared (FTIR) spectroscopy and pyrolysis mass spectrometry (Py-MS). In this article new Py-MS data on low temperature oxidation effects in several U.S. coals of different rank and origin are discussed with special emphasis on the role of different coal macerals.

38472 **Aerial oxidation of maceral isolates from an Australian bituminous coal.** Pandolfo, A.G.; Johns, R.B.; Nichols, P.D.; White, D.C. (Dept. of Organic Chemistry, Univ. of Melbourne, Parkville, Victoria 3052). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 171-178(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A comparative study of the relative reactivities of Run-of-the-Mine (ROM) Blair Athol coal and constituent maceral lithotypes, fusain and vitrain to laboratory oxidation conditions at 100°C is reported using a surface reflectance FTIR technique (DRIFT). The DRIFT spectra of pure maceral isolates established the aliphatic content to be in the order of exinite >> vitrinite > inertinite.

The difference spectra of the maceral lithotypes fusain and vitrain show the ready loss of aliphatic groups in the former as an early oxidation step. Oxygen uptake by vitrain is initially slow compared with ROM and fusain coals.

38473 **Microstructural variations of three American coals and their high temperature chars.** Jiang, W.D.; Lee, I.C.; Yang, R.Y.K. (Dept. of Chemical Engineering, West Virginia Univ., Morgantown, WV 26506-6101). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 247-258(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Microstructure of a North Dakota lignite, a Washington subbituminous and a New Mexico bituminous coal and their chars produced by devolatilization in nitrogen at 1000 to 1300°C was investigated in this work using the CO/sub 2/ adsorption method conducted at 25°C. For each coal and char, specific surface area, micropore volume, micropore surface area, mean equivalent radius of micropores and characteristic energy of adsorption, as well as micropore volume distribution, were determined and tabulated, and their variations with devolatilization temperature studied and interpreted. It was found that, overall, specific surface areas, micropore volumes and micropore surface areas of chars decreased monotonically as devolatilization temperature was raised from 1000 to 1300°C, although most of these values were much larger than that of their parent coals.

38474 **Reactivity of low-temperature chars: Significance of char active surface area as a reactivity parameter.** Khan, M.R. (U.S. Dept. of Energy, Morgantown Energy Technology Center, P.O. Box 880, Morgantown, WV 26507-0880). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 298-309(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

In this study, the reactivity of chars prepared at mild (low-temperature) conditions has been addressed. A thermogravimetric analysis system (TGA) was used to determine the reactivity of chars in air or O/sub 2/ using isothermal or nonisothermal techniques. Coal chars were prepared in a TGA or in a slow heating rate organic devolatilization reactor (SHRODR) at a temperature range between 500° and 950°C. The chars prepared by mild pyrolysis of coal at 500°C are shown to be highly reactive. Comparison of reactivities of low- and high- temperature chars shows that the low-temperature chars exhibit higher reactivity than both the parent coals and the high-temperature chars.

38475 **In situ acetylation study of a subbituminous coal by diffuse reflectance infrared Fourier transform (DRIFT) spectroscopy.** Smyrl, N.R.; Fuller, E.L. Jr. (Plant Lab., Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 337-347(Apr 1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Diffuse reflectance infrared Fourier transform (DRIFT) spectroscopy has been utilized to monitor the in situ acetylation of a powdered subbituminous coal at the Oak Ridge Y-12 Plant. The acetylation reaction was carried out by the adsorption of acetic anhydride onto the powdered coal from the gas phase with subsequent heating above 100°C required to initiate the reaction. This technique can be used to gain insight into the hydroxyl (O-H) content of the specific coal sample under study by simultaneously observing the disappearance of infrared absorptions due to various types of O-H functional groups and the appearance of absorptions due to carbonyl functional groups resulting from reaction with the anhydride.

38476 **Electrokinetic behavior of coal.** Fuerstenau, D.W.; Rosenbaum, J.M.; You, Y.S. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 378-385(Apr 1987). (CONF-870410—).

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Electrokinetic measurements show that coals generally exhibit a charge reversal at a certain pH because the surface charge on coal is controlled by the dissociation/ionization of oxygenated functional groups on the coal matrix and by the presence of siliceous contaminants. The lower the ash mineral content of a coal, the higher is the pH at which the charge is reversed (that is, its PZR). De-ashing a coal cases it to exhibit a higher PZR. Increased oxidation causes the pH for charge reversal to decrease due to the higher concentration of oxygen functional groups.

38477 **Assessing oxidation and the wettability of coal by a film flotation technique.** Fuerstenau, D.W.; Williams, M.C.; Narayanan, K.S.; Diao, J.L. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 417-424(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The wettability of various as-received and oxidized coals can be quantified by a film flotation technique developed in our laboratories. Film flotation response curves yield an average wetting tension that can be used as an index for correlating the behavior of coals with their composition, treatment, process behavior, etc. The shift in average wetting tension with oxidation provides a quantitative measure of the change in the surface energy of the coal induced by the increase in oxygen functional groups.

38478 **Density separation of chemically modified coal macerals: A two dimensional separation method for more homogeneous macerals.** Dyrkacz, G.R.; Choi, C.Y.; Stock, L.M. (Argonne National Lab., Chemistry Div., 9700 South Cass Avenue, Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 448-456(Apr 1987). (CONF-870410—). Contract W-31-109-ENG-38.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

That coal is a very physically and chemically heterogeneous substance is one of the few facts about coal that has not been contested in the long history of coal research. However, the extent and nature of that heterogeneity is not at all clear. Coal heterogeneity is due to several elements: The varied diagenesis and catagenesis of the original organic plant constituents, specific associations and interactions of macerals from different paleo-environments, and the different mineral constituents of coal. Even though the heterogeneity is practically self-evident and is a major obstacle to defining the structural elements of coal, remarkably little work is directed toward exploring methods to reduce the heterogeneity prior to structure elucidation. Density gradient centrifugation (DGC) appears to be one of the most effective separation methods for reducing the heterogeneity of coal by separating the three maceral groups, and concomitantly provides some idea of the range of physical and chemical variation that exist within a coal sample.

38479 **Two dimensional solid state NMR methods applied to whole coals and chemically modified coals.** Zilm, K.W.; Webb, G.G.; Millar, J.M. (Dept. of Chemistry, Yale Univ., 225 Prospect Street, New Haven, CT 06511). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 457-462(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Two dimensional NMR methods have been shown to provide a much finer accounting of the functional types present in coals than by CPMAS spectroscopy alone. The ADIPSHIFT method has been shown to be at least as quantitative as CPMAS both in theory and experimentally. The method gives reliable distri-

butions of carbons with differing multiplicities which is useful in identifying different functionalities that overlap in chemical shift. Recent studies of a model system indicate that the connectivity of the different groups in chemically modified coals should be obtainable from solid state COSY and NOESY experiments. This type of information will provide a very accurate picture of the structure of the alkylated sites and the substitution patterns surrounding them.

38480 **The eight coals in the Argonne premium coal sample program.** Vorres, K.S.; Janikowski, S.K. (Chemistry Div., Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 492-499(Apr 1987). (CONF-870410—). Contract W-31-109-ENG-38.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The full set of eight coals for the Premium Coal Sample Program includes a lignite, subbituminous, high volatile, medium volatile and low volatile bituminous, as well as a resinite rich, an inertinite rich and a Pittsburgh #8 coking coal. The coals were selected on the basis of C, H, S and O content as well as maceral content and geological age. Ampoules are typically available in 5 grams of -100 mesh or 10 grams of -20 mesh material. Some analytical information is available. The method of selection, collection, transportation, processing, packaging, distribution and characterization are summarized.

38481 **The relationship between cation mobility and acid-base behavior in coal ash and similar oxide systems.** Vorres, K.S. (Chemistry Div., Argonne National Lab., Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 500-504(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Acids and bases were defined earlier in terms of the ionic potential or cationic charge/radius ratio. Values range from about 10 for acids to about 1 for bases when crystallographic radii in Angstrom units are used. The ionic potential reflects the relative attraction of a cation for charges on a uniform anionic surface. Surface cations have different mobilities on a common anion surface. The most basic ions have the greatest mobility due to the relatively weak attraction for surface anions, which minimizes the energy requirement for surface diffusion and leads to an enhancement of sintering.

38482 **Characterization of a resinite maceral fraction.** Bodily, D.M.; Kopp. (Dept. of Fuels Engineering, Univ. of Utah, Salt Lake City, UT 84124). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 554-557(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Resinite in coals is attributed to plant resins and essential oils in leaves which are converted during coalification to spherical or oval shaped bodies and occasionally lenses or thin bands of fluorescing materials. Chemically, the resins consist of terpenoid structures. In a study of the swelling of coal macerals in organic solvents, a resinite maceral fraction was separated from Hiawatha, Utah coal. Hiawatha coal is from the Wasatch Plateau field, and dates from the Cretaceous period. Coals of the Wasatch Plateau are relatively rich in resinite. As part of the study of maceral swelling, the properties of the resinite fraction were measured.

38483 **Oxidations of coals at ambient temperatures.** Mayo, F.R. (SRI International, Menlo Park, CA). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 558-563(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

This paper extends the work of others on the weathering of coal. They crushed freshly-mined Illinois No. 6 Coal (Monterrey Mine) to a maximum size of 6.4 mm, spread it over the ground, and allowed it to weather with daily mixing. Samples were removed periodically and Soxhlet-extracted with tetrahydrofuran. The amount extracted (dmmf basis) decreased from 21.3% at zero time to 14.5% at 56 days and then did not change further. During the exposure, the dmmf carbon content of the coal decreased from 69.3 to 66.9% and its oxygen content increased from 9.0 to 11.3%. No new carbonyl groups were found by FTIR and the phenol and carboxyl contents did not change.

38484 **Use of SEM with wavelength-dispersive spectrometry for organic oxygen in coal.** Norton, G.A.; Younkin, K.A.; Straszheim, W.E.; Markuszewski, R. (Ames Lab., Iowa State Univ., IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 564-570(Apr 1987). (CONF-870410—). Contract W-7405-ENG-82.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Scanning electron microscopy (SEM) and wavelength-dispersive spectrometry (WDS) were used to determine organic oxygen in four geographically diverse coals and in amber. Subsequent to the previously reported feasibility study, analytical modifications and refinements in sample handling and preparation were made. In addition, the precision of the SEM-WDS analyses was examined. SEM-WDS results were comparable to values obtained by neutron activation and by the indirect ASTM procedure for one coal, while significant discrepancies were observed for the other coals and the amber.

38485 **Hydrogen bonding and coal structure.** Painter, P.C.; Nowak, J.; Sobkowiak, M.; Youtcheff, J. (Polymer Science Program, Penn State Univ., University Park, PA 16802). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 576-582(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

There is now a wealth of literature that discusses coal structure in terms of the concepts of polymer science. Coal is considered to be a macromolecular network with a degree of cross-linking and a sol/gel ratio (soluble extract/insoluble network) that varies with rank. Recent work on swollen polymer gels clearly demonstrates that measurements on the swelling of coal have to be considered in a totally different fashion. In this paper the authors attempt to critically assess these factors. In particular, they point out the key role played by hydrogen bonding in coal structure and how the presence of such strong, directional interactions does not permit the use of Flory-Huggins solution theory. They then discuss aspects of various new theoretical approaches that hold promise for describing the structure of coal.

38486 **Studies on the reaction of coal with ethoxycarbonylcarbene.** Pomerantz, M.; Rooney, P. (Dept. of Chemistry, The Univ. of Texas at Arlington, Arlington, TX 76019-0065). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 583-588(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Studies of the molecular structure of coal have relied heavily on the chemical reactions of the coal and on the structure of the products produced. Many of these reactions involve high temperatures and fairly severe conditions, and, as a result, it is frequently difficult to relate the reaction products to coal structure because of the molecular rearrangements and unanticipated reactions. For this reason people have sought mild reactions which would deploymerize the coal and provide tractable, identifiable products. Ethoxycarbonylcarbene produced by the mild thermal decomposition of ethyl diazoacetate has been reacted with Illinois No. 6 coal. Thermal analysis has shown that the treated coal is considerably more volatile than untreated coal and that the temperature of maximum volatility is significantly reduced. Infrared studies, have shown that in addition to the appearance of ester carbonyl absorption in the treated samples, there were also peaks attributable to aromatic rings and to mineral matter which diminish and peaks attributable to alkenes which also appeared. This is consistent with the known reactions of ethyl diazoacetate and ethoxycarbonylcarbene.

38487 **Intrinsic viscosity of lignite-derived preasphaltenes and model compounds.** Argasinski, J.K.; Jones, M.B. (Dept. of Chemistry, Univ. of North Dakota, Box 7185, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 604-610(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

In connection with studies of intermolecular attractive forces in coal-derived liquids, the authors have measured the intrinsic viscosities of more than 60 model compounds and 6 lignite-derived preasphaltenes in THF solution. The goal of this project was to use well defined model compounds to assess the importance of various structural features, including molecular weight, functionality, and degree of aromatic condensation, to the intrinsic viscosity of the preasphaltenes.

38488 **Direct imaging of time-averaged flow patterns in a fluidized reactor using X-ray computed tomography.** Banholzer, W.F.; Spiro, C.L.; Kosky, P.G.; Maylotte, D.H. (General Electric Co., Corporate Research and Development, K1-CEB 410, Schenectady, NY 12301). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 763-767(Apr 1987).

X-ray computed tomography (CT), a technique which has revolutionized medical imaging diagnostics, has been applied to the study of fluidization. In particular, a model fluidized bed reactor containing powdered coal was placed inside a medical CT device and scanned under a range of experimental conditions. The CT technique enables nondestructive, noninvasive visualization based on differences in the X-ray attenuation. For coal, X-ray attenuation is dominated by Compton scattering so that visualization is essentially that of the localized bed density to an excellent approximation. Spatial resolution is 0.087 mm/sup 3/, while density resolution is better than 30 kg/m/sup 3/. Density differences within the confines of the fluidized bed were observed and quantified. Gradients in static, fluidized, and spouted beds were observed.

0108 Waste Management

REFER ALSO TO CITATION(S) 38439, 38798, 38799, 38800, 38802, 39572, 39574, 39625

38489 **(NP—7770130) Development of methods to assess dumping characteristics.** Huenert, R. (Paderborn Univ. (Gesamthochschule) (Germany, F.R.). Abt. fuer Naturwissenschaften 2). 20 Oct 1986. 139p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770130.

Lysimeters are presented that enable investigations of the dumping characteristics of power plant waste under realistic conditions. The dumping characteristics of a material can be determined within a period of 1 to 3 years. Natural influencing parameters are taken into account including microbial transformations or mineralogical changes in a material. The water balance is determined in order to estimate the penetrating fraction of water. Laboratory methods were developed for modelling the dumping characteristics of a given material.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 38501

38490 **Potential advantages and pitfalls in determining cost-effective emission control strategies to reduce acid deposition.** Streets, D.G. New York, NY; American Institute of Chemical Engineers (1985). 22p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract W-31-109-ENG-38.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 32G.

There is no strategy that is clearly the best from every standpoint. Those bills, such as Sikorski-Waxman, that attempt to preserve coal markets are very expensive. The cost-effective strategies, such as the Udall-Cheney bill, cause large disruptions in the coal industry. The deposition-optimized strategies are much cheaper but do not afford such widespread environmental protection. All strategies, to varying degrees, cause inequitable cost burdens among states, which could be remedied by cost sharing schemes. The work at Argonne National Laboratory has examined many facets of the cost-effective options and the authors conclude that they offer significant advantages over the majority of congressional proposals.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 38442

38491 **(NMRDI—2-74-4331) Quality assessment of strippable coals in New Mexico, Year 2, Phase 2, Fruitland, Menefee, and Crevasse Canyon formation coals in the San Juan basin of northwestern New Mexico.** Roybal, G.H.; Campbell, F.W.; Beaumont, E.C.; Cohen, A.D.; Kuellmer, F.J.; Kottlowski, F.E.; Cook, K.H. (New Mexico Bureau of Mines and Mineral Resources, Socorro (USA); New Mexico Univ., Albuquerque (USA). New Mexico Research and Development Inst.). May 1987. 112p. NTIS, PC A06/MF A01 - New Mexico Research and Development Institute, 1220 South St., Francis Dr., Santa Fe, NM 87501. File Number DE87900903.

Drill sites spaced about 2 miles apart along the down-dip edge of strippable coal yielded 181 coal-core samples from 2 Fruitland Formation, 36 Menefee Formation, and 18 Crevasse Canyon Formation locations in the San Juan Basin. Extensive chemical analyses and representative petrographic descriptions characterize the sampled coals and indicate their commercial qualities. 13 refs., 22 figs., 16 tabs.

0120 Mining

REFER ALSO TO CITATION(S) 38503, 39360

38492 **(CONF-8609299—) 17th trade union congress of IG Bergbau und Energie. Protocol.** (Industriegewerkschaft Bergbau und Energie, Bochum (Germany, F.R.)). 1986. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752614.

From 17. trade union congress of IG Bergbau und Energie; Duisburg, F.R. Germany (12 Sep 1986).

The opening address delivered at the 17th trade union congress in Duisburg in 1986 points out the problem areas to be found in all sectors of the mining industry: Deposits presenting problems, international competition, interlocking with the secondary branches of the economy, basic materials industry. The first lecture on the model 'Participation in the mining industry - experience and demands' wants to revise and strengthen the insufficient participation act of 1976 by extending it to other economic branches. The second lecture 'Indigenous coal - safety pillar of energy policy' wants to see the continuity of coal policy safeguarded by fulfillment of the contents, and by continuation, of the 'century contract'. This is followed by a discussion, the report of the committee supervising the delegates' mandates, and elections. The closing address underlines the party-political independence of this unified trade union and its functional capacity. (HSCH).

38493 (CONF-8609299—, pp 14-24) **Model 'participation in the mining industry' - experience and demands.** Schmidt, W. 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752614.

From 17. trade union congress of IG Bergbau und Energie; Duisburg, F.R. Germany (12 Sep 1986).

The IG Bergbau und Energie demands that participation in the mining industry be permanently laid down by law as the first step in a comprehensive plan towards establishing participation in enterprises on a large scale. To counteract the danger of participation in the mining industry becoming devoid of meaning, it is to be extended to other branches of the economy, thereby driving back the insufficient industrial participation act of 1976. Individual elements of a participation law on a parity-basis must be for instance: Equal rights and equal weight of worker and shareholder represent-

atives in the supervisory board, strengthening of the supervisory board by minimum competencies, extension of the scope by fixing the number of regularly employed persons at 1000. (HSCH).

38494 **(DOE/EIA—M024) Documentation of the inputs to the Resource Allocation and Mine Costing (RAMC) model.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Jun 1987. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012689.

Each chapter documents a separate group of RAMC input parameters. Chapter 2 documents parameters used to allocate the reserves to new mines (including, for example, the total surface reserves, the overburden ratio distribution, and the clean coal yields); Chapter 3 covers parameters representing various costs of mining not calculated internally by the RAMC (e.g., coal royalties, severance taxes, and license fees); Chapter 4 covers parameters used in the financial calculations (e.g., the utility discount rate, the model mine costs escalator, etc.); and Chapter 5 covers parameters defining the existing mine steps on the supply curves (e.g., existing production and existing price).

38495 **(NP—7770127) Optimum use of lithium bromide/water absorption refrigerators in mine air conditioning.** Schniewind, B.J. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Bergbau und Geowissenschaften). 26 Feb 1985. 160p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770127.

In order to investigate the economic efficiency of lithium bromide/water absorption refrigerators in central surface refrigeration systems, a model was developed and implemented on a data processing system for simulating the operation of a refrigerator system and for determining the influence of different parameters on the absorption refrigeration process. In combination with an extended programme for evaporation refrigerators, the model is able to calculate the performance of absorption refrigerators whose cooling water is cooled by evaporation cooling.

38496 **(NP—7770145) Reducing the strain on people in workplaces endangered by gas outbreaks. Final report.** (Preusseag A.G. Kohle, Ibbenbueren (Germany, F.R.)). 1986. 401p. (In German). NTIS (US Sales Only), PC A18/MF A01. File Number DE87770145.

In spite of the complex processes, in the origin and course of gas coal outbreaks, the extensive work in these research and development project has made considerable progress in some areas. By detecting and quantifying outgassing processes, a safe assessment of relief drilling measures could be made, and a reduced frequency and lesser effects of gas-coal outbreaks recently point to indirect effects of the improvements worked out. With the progress made, the physical and psychological strain on miners in seams endangered by gas outbreaks could be considerably reduced.

0140 Combustion

REFER ALSO TO CITATION(S) 38429, 38430, 38464, 39462

38497 **(DGRST—81-D-1351) Optimization of combustion-gasification of solid fuels in circulating fluidized beds.** Chrysostome, G.; Marcellin, M.; Wang, R.; Galant, S.; Patureau, J.P.; Rebuffat, D. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Jul 1983. 24p. (In French). (DGRST—81-D-1352). NTIS (US Sales Only), PC A02. File Number DE87752659.

Circulating fluidized beds are characterized by a high gas speed (3 to 10 m/s), particles carried along are separated from the gas flux by a cyclone and recycled at the base of the reactor. Advantages are: a greater thermal load, a better use of the volume, use of smaller particles increasing reaction surface, better temperature control, improvement of heat and mass transfer, adjustment by recycling ratio and combustion efficiency of 99 per cent. This technology is studied for combustion of ash-containing fuel (schistes) or sulfur-containing fuel (lignites) or solid petroleum residues and for coal gasification. The pilote plant and tests are described. A mathematical model is developed for optimization of combustors and coal gasification.

38498 **(DOE/MC/21387—2359) Use of solid collectors for control of emissions in advanced coal conversion processes: Final report.** Klinzing, G.E.; Blachere, J.R.; Weintraub, M.; Martello, D.; Shannon, S. (Pittsburgh Univ., PA (USA). School of Engineering). Dec 1986. Contract AC21-84MC21387. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87006491.

In a study of methods for removing trace contaminants from hot products of coal combustion, a combustor was constructed to provide a closely controlled environment for a small pulverized fuel flame. Various materials selected as candidates for contaminant collection were mixed with a pulverized North Dakota lignite used as the fuel. Residence times of the particles were estimated to vary from 1.5 to 3 seconds in an atmosphere that ranged from -32% to +265% excess air with temperatures of 650°C to 900°C. The ash and collectors removed from the flue gases were characterized by scanning electron microscopy and EDS/WDS microprobe analysis. It was found that activated alumina adsorbed significant amounts of sodium from the flame. Other materials, such as emathlite, adsorbed similar amounts of sodium. A correlation between excess air and Na adsorption on the activated alumina showed that a sharp increase in adsorption occurred with increasing excess air up to a maximum near 100% excess air. This maximum was approximately 2200 ppM by weight +-30%. A porous silica glass exhibited a narrower adsorption range over a wide range of temperature and excess air, with an average of about 60 ppM adsorption and a maximum of 90 ppM. Calculations combining the measured sodium adsorption with published citations of sodium concentrations in flue gases and turbine requirements suggested that around 5 weight percent of activated alumina in coal could provide the necessary reduction of sodium content for a gas turbine feed. 20 refs., 28 figs., 11 tabs.

38499 **(EPRI-CS—5296) Evaluation of alternative steam generator designs for Atmospheric Fluidized-Bed Combustion plants: Final report.** Dunlop, W. (Bechtel Group, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 344p. Research Reports Center, Box, 50490, Palo Alto, CA 94303. File Number TI87920511.

The Atmospheric Fluidized Bed Combustion development program at the 20 MW pilot plant at TVA's Shawnee Station is addressing several design issues related to the scale-up requirements for utility application. These include use of overbed vs. underbed feed systems for coal, limestone, and recycled solids, load following and control design for reliable operation, and economies of scale. After initial screening of several alternate configurations, conceptual designs of AFBC mechanical overbed and underbed feed power plants in 1 x 200 MW and 2 x 500 MW sizes were prepared. These designs were assessed for efficiency, performance, resource requirements, capital cost and levelized busbar costs and compared to conventional pulverized coal units of similar size. The findings are that relative to the AFBC underbed feed plants, the AFBC overbed feed plant is about $70/kW less expensive at the 200 MW size, and $20/kW more expensive at the 2 x 500 MW size. Also, the capital costs of AFBC units range from $20/kW to $130/kW less than conventional PCF units and the potential exists for further reductions in AFBC capital costs as AFBC technology improves. Levelized busbar costs are essentially the same for both types and sizes of the AFBC units and for the conventional PCF units. Only one coal, Illinois #6 - a high sulfur bituminous coal - was initially evaluated. Subsequently, five additional coals - bituminous, subbituminous and lignite - and plant locations were evaluated. Current testing of less expensive coals is expected to confirm the fuel flexibility of the AFBC units which may result in corresponding reductions in levelized busbar costs. Utility industry confidence in AFBC has recently been expressed by the planned design and construction of fluidized bed units in 100 MW to 160 MW sizes for Colorado Ute Electric Association, Northern States Power Co. and TVA. 5 refs., 38 figs., 54 tabs.

38500 **Photofragment fluorescence as an analytical technique for gas-phase alkali compounds.** Oldenborg, R.C.; Baughcum, S.L.; Hof, D.E. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp MB3.1-MB3.3 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

A recent investigation of the photodissociation of gas-phase sodium and potassium chlorides to produce excited alkali atoms has shown that the photofragment fluorescence technique can measure these compounds at concentrations down to sub-part-per-billion levels and is linear over at least six orders of magnitude. The photodissociation of other gas-phase alkali compounds has not been previously investigated. Absorption by vibrationally excited compounds is important at the temperatures of interest, and this "hot-band" absorption significantly broadens the bands in the photodissociation spectra to longer wavelengths. Considering a Boltzmann energy distribution and assuming comparable sensitivities, the authors estimate that if the threshold energies differ by at least 10 kcal/mol, then 100:1 discrimination can be achieved given some knowledge of the temperature. The variation in threshold energies shown is large enough that good discrimination between compounds containing the same alkali but different major anion groups (halides, hydroxides, monoxides, diodes, and sulfates) should be feasible. However, interference between the different monoxides of the same alkali is likely. Recent experimental results on photodissociation of sodium and potassium hydroxides are presented and compared to previous results on the corresponding chlorides. The new alkali hydroxide data demonstrate that the wavelength dependence can indeed be used to discriminate between chlorides and hydroxides. The issue of relative sensitivity is also addressed.

38501 **In situ elemental analysis of particulate fuels using laser spark spectroscopy.** Ottesen, D.K.; Radziemski, L.J. (Sandia National Labs., P.O. Box 969, Livermore, CA 94550). pp TuA6.1-TuA6.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

One of the most challenging areas for coal combustion diagnostics is that of determining the composition of entrained coal, char, and mineral matter particles in the combustion zone. The authors are currently evaluating the potential of laser spark spectroscopy as a non-intrusive optical diagnostic for such studies. The technique uses a high power pulsed laser beam focused on a target to form a high temperature plasma which results in an intense emission spectrum. The spectral lines are then used for qualitative analysis of the sample. A brief review of various demonstrations experiments is given previously. A primary research goal in the present study is the simultaneous measurement of size and composition of individual coal particles. A schematic diagram of our apparatus for this experiment is presented in this paper. The particle size was obtained using forward scattering data as described elsewhere. The sizing laser beam also provided a trigger for a Q-switched Nd:YAG laser, which was operated at 5320 A (doubled) with a pulse width of 7 nsec and energies below the air breakdown threshold of about 35 mJ (15 cm f.l. lens). The focused beam evaporated all or part of a coal particle forming a high temperature plasma with a luminous lifetime greater than 20 μsec. The intense emission lines were viewed with a 0.5-m Spex monochromator with a 700-element intensified diode array detector. At early times in the plasma (less than 1 μsec) the emission spectrum was very complex (1,3,4) consisting of a strong continuum plus ionized atomic lines. As time progressed, the continuum and spectra of ions died out leaving predominantly spectra of neutral species. The results obtained are presented in this paper.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 38492, 38494

38502 (CONF-8609299—, pp 25-37) **Indigenous coal - safety pillar of energy policy.** Meyer, H.W. 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752614.

From 17. trade union congress of IG Bergbau und Energie; Duisburg, F.R. Germany (12 Sep 1986).

After the crisis of the steel industry, black coal is faced by problems that threaten its existence, and serious losses are forced on brown coal through nuclear power plants. The IG Bergbau und Energie therefore demands: Brown coal extraction in the mining district on the Rhine must again be increased to 120 million tons per year. Black coal must be drawn on for power generation to the same extent as up to 1984. The agreements in the so-called century contract on power generation from black coal must be fulfilled to the full. Already now, binding agreements must be concluded to the effect that German black coal will continue to be used for power generation after 1995. There must not be any extension of electric power imports beyond the current quantities of electricity imports. Coal imports must not restrict home production. A continuity must be maintained in coal policy. (orig./HSCH).

38503 **(DOE/EIA—0125(87/1Q)) Coal distribution, January-March 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 1 Jul 1987. 101p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87012642.

The Nation's coal industry produced 221.7 million short tons from January through March 1987, 2.4% below the record first quarter output reached in 1986. The amount of coal distributed to both domestic and foreign markets during the period totaled 217.0 million short tons, a decrease of 2.6% from the level in the first quarter of 1986. During the first quarter of 1987: coal shipments to each domestic consumer sector dropped below those a year earlier; coal exports fell to a 5-year first-quarter low; coal stocks at producers and distributors totaled 36.6 million short tons on March 31, 1987, 13.9% more than on December 31, 1986; coal shipments from Districts 9 and 15 in the Interior Region and District 20 in the Western Region reached a 5-year first-quarter high; and of the nine Census divisions, only the South Atlantic received more coal than in the comparable period of 1986. 6 figs., 33 tabs.

0160 Health And Safety

REFER ALSO TO CITATION(S) 38496, 39648

38504 **(STEV—1986-R23) Occupational environment of mining, production and transport of certain fuels for power and heating plants. After Chernobyl.** Hagerman, Y. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 82p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751971.

The risks and occupational injuries are described. The actual fuels are coal, fuel oils, natural gas, peat and wood fuels, the latter two being considered as indigenous. The frequency and causes of accidents are presented. (G.B). With 52 refs.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 38492, 38493

02 PETROLEUM

0201 Reserves

38505 **(OCS/MMS—87-0016) Alaska summary/index: January 1986-December 1986: Outer Continental Shelf oil and gas activities.** Slitor, D.L.; Wiese, J.D. (Minerals Management Service, Vienna, VA (USA). OCS Information Program). 1987. 141p. Minerals Management Service, P.O. Box 101159, Anchorage, AK 99510. File Number TI87900894.

This consolidated document chronicles OCS related developments for all Alaska OCS Region planning areas. Topics discussed include offshore oil and gas resources of the Alaska region; magnitude and timing of OCS activities; and oil and gas transportation strategies and onshore support facilities. (ACR)

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 39362, 39476

38506 (CONF-8610274—Absts., pp 7) **Sequences of sedimentation in the Miocene of the Central Vienna Basin and their importance for hydrocarbon exploration.** Kreutzer, N. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38507 **(NP—7770152) Investigation of the stability of water based drilling fluids in realistic conditions.** Behrens, J. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1986. 162p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770152.

Long term experiments lasting 120 hours and short term experiments lasting 12 and 24 hours were done in the context of this work to examine the stability of different chalk drilling fluids containing solid particles with high concentrations of sodium or potassium salts. The effects of temperatures up to 160/sup 0/C, mechanical stresses and time are determined. Special attention is paid to loads on the drilling fluids due to temperature changes.

38508 **(PB—87-183281/XAB) Catalog of geological and geophysical data for the National Petroleum Reserve in Alaska.** Ikelman, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Dec 1986. 117p. (KGRD—16-REV). NTIS, PC A06/MF A01.

Key to Geophysical Records Documentation.

The catalog summarizes geophysical and geological data available for the National Petroleum Reserve in Alaska (NPRA). Data holdings include those from the disciplines of seismics (reflection and refraction), gravity, magnetics, topography, well logs, geothermics, and earthquake seismology.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 38538, 38545

38509 **(AEEW-M—2323) Some considerations relevant to extending fractional flow theory to unstable immiscible flow.** Murphy, P.; Hughes, D.S. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1986. 50p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The immiscible displacement of one fluid by another in a porous medium is an important mechanism in both secondary and tertiary oil recovery. Research to find a pseudo fractional flow curve and associated pseudo relative permeabilities which describe the averaged effects of unstable, fingered, flow when there is a varying water saturation behind the finger front is described. Potential use of such pseudo relative permeabilities with a conventional numerical simulator to represent the gross effects of unstable immiscible flow is considered.

38510 **(AEEW-R—1677) Preliminary studies using the thermal processes simulator ISCOM to model laboratory combustion tube experiments.** Durkin, A.; Hughes, D.S. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1983. 72p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A combustion simulator, the Computer Modelling Group (Calgary) program ISCOM, the data requirements to model in situ combustion, and possible sources of these data are described. ISCOM is used to model the published results of three sets of combustion tube experiments performed using light oils at post waterflood conditions. The results of these simulations are reported and the sensitivity of the results to particular parameters is explored. The influence of the injected water/air ratio was found to be particularly important on the mode of combustion. The results also highlighted specific problems in performing combustion tube experiments and the importance of remedying these in future experiments.

38511 **(AEEW-R—2097) Measurement of polymer gel strengths using a gun rheometer.** Hubbard, S. (UKAEA Atomic Energy Establishment, Winfrith. Chemistry Div.). Sep 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752794.

Gels for enhanced oil recovery have been made by crosslinking the biopolymer, xanthan, with chromium (III) ions. The yield strengths have been measured with a gun rheometer and the variation with polymer and chromium concentrations has been studied. Gel strength increases with increasing xanthan concentration. The age of the gel does not appear to affect the yield stress. Acidity has been shown to influence the gelation reaction and its effect is discussed.

38512 **(AEEW-R—2103) NMR imaging as an aid to experimental enhanced oil recovery.** Puckett, D.A.; Sims, R.J. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. 36p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

NMR imaging has been used to visualise fluids in core samples without the addition of labels or dopants. The technique showed good contrast when two different fluids were present enabling fingering to be visualised.

38513 **(CONF-8610274—Absts.) Autumn meeting of Austrian Society for Petroleum Sciences. Abstracts of papers.** (Oesterreichische Gesellschaft fuer Erdoelwissenschaften, Vienna (Austria)). 1986. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

This is a collection of the abstracts of contribution to the meeting concerning the exploration and winning of petroleum and natural gas as well as the working of petroleum products. Separate records are available for most papers.

38514 (CONF-8610274—Absts., pp 3) **Blowouts in deep-well drilling.** Spoerker, H.; Logigan, S. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38515 (CONF-8610274—Absts., pp 4) **Problems of accuracy and expenditure of well logging.** Fruehwirth, R.; Lorbach, M. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38516 (CONF-8610274—Absts., pp 5) **Side-track experiments from cased wells.** Bacher, R. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38517 **(DGMK—202-3) Enhanced oil recovery - carbon dioxide flooding. Laboratory investigation and mathematical simulation. Final report.** Pusch, G.; Meyn, R.; Mueller, T. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.); Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). Dec 1986. 194p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-08604.

In a previous R+D-phase (DGMK-Project 202, 03E-3048-A) the potential effectiveness of carbon dioxide flooding as EOR-method was experimentally varified. Field pilots are necessary for further improvements of this still risky EOR-technology. Mathematical models are needed for the computer based planning and evaluation of those field pilots, basing on the physical background of oil mobilisation mechanisms. The physics of residual oil mobilisation and their handling in simulation tools were investigated in this project. A flooding cell has been developed with the aim of determining the residual phase and component distributions as functions of the position. On the basis of the distribution thus measured, additional conclusions can be reached for the displacement and extraction mechanism of the carbon dioxide flooding process. By variation of the flood parameters, the influence of fingering has been investigated and the required amount of carbon dioxide has been determined. In an accompanying simulation study, core flooding tests have been matched and predicted by means of the compositional simulator, COMP II from SSI. Among other features, the results indicate that the description of the PVT behaviour of the hydrocarbon - carbon dioxide system employed, especially the correct characterization of the heavy hydrocarbon fractions, with the use of an equation of state, is an essential prerequisite for a successful simulation. With 81 figs., 5 tabs.

38518 **(DGRST—81-D-0093) Study of the influence of surfactant and cosurfactant structure on monophase extent of water/oil/surfactant/cosurfactant systems and determination of structural parameters of these systems near phase separation. Final report.** Lang, J.; Lianos, P.; Zana, R.; Dinh Cao, M.; Rueff, R. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 7 Oct 1983. 47p. (In French). NTIS (US Sales Only), PC A03. File Number DE87752666.

Results reported concern the effect of the nature of the surfactant (sodium dodecylsulfonate, tetradecylsulfate or hexadecylsulfate) of the alcohol (1-propanol, butanols, pentanols or 1-hexanol) and of the hydrocarbon (toluene, cyclohexane or dodecane) on microemulsion formation. One phase domain and size of surfactant + cosurfactant micelles and oil droplets in the water rich system are examined. Phase diagrams are studied for the surfactant + cosurfactant influence. Influence of alcohol on phase inversion oil in water and water in oil microemulsion are determined by electric conductivity. The size of oil rich droplets dispersed in a continuous water rich phase is determined by a fluorescence method. The change of the surfactant aggregation number depends strongly on the relative lengths of the alkylchain of the alcohol and alkane, as well as on the isomerism of the alkane.

38519 **(FRNC-TH—2067) Surface tension of an oil-water system with a microemulsion. Development of an experimental technique.** Gonzalez-Morillo, H. (Institut National Polytechnique, 31 - Toulouse (France)). 16 Nov 1981. 189p. NTIS (US Sales Only), PC A09. File Number DE87752669.

Enhanced oil recovery and particularly by microemulsion flooding is briefly recalled and works concerning the dynamical aspect of the process are reviewed. First experiments on oil detrapping in a glass capillary are described. Trapping techniques are presented and then for surface tension determination the meniscus is studied optically. Experimental results of detrapping by a microemulsion are examined stressing the evolution of oil-water surface tension. A simple diffusion model is used to describe this evolution with time. Another diffusion experimental system based on the shape of a drop is described and experimental results are presented in particular the evolution of the microemulsion front, the volume of the oil phase and oil-water surface tension. Diffusion models and surface tension vs time curves are analyzed.

38520 **(IFP—32-295) Influence of interfacial parameters in crude oil trapping mechanism.** Thiebot, B. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). 26 Jul 1984. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752668.

Enhanced oil recovery by chemical processes use injection of water with additives to decrease capillary forces which are trapping residual oil in a porous medium. The action mechanism of these additives is presented in this thesis. Influence of porous medium structure, surface tension between water and oil, rock wettability by these two fluids on displacement of oil by water are studied. Surface tension is an essential parameter and a simple equipment is developed for measuring low surface tension by sessile-drop method and the hanging drop method at atmospheric pressure and high hydrostatic pressure. Influence of pressure up to 1000 bar and temperature up to 300/sup 0/C on low surface tension are examined. Influence of pore size and surface tension is studied by displacement in a porous medium in three different rock samples.

38521 **(IFP—33-748) Adsorption kinetics of anionic surfactants on clays.** Rozieres, J. de. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). 17 Dec 1985. 179p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752671.

Adsorption kinetics of Na-dodecyl-benzene-sulfonate on kaolinite is studied in a continuous flow cell, stirred to maintain the clay in suspension and to obtain a homogeneous mixture avoiding surfactant diffusion toward clay. A constant surfactant ratio is injected and concentration ratio is measured at the cell outlet allowing the determination of surfactant concentration in the cell, adsorbed quantity and its variation with time. Na DBS adsorption is obtained in 2 steps: a step limited by surfactant adsorption kinetics leading to a pseudo-equilibrium in few hours; a slow step assigned to kaolinite dissolution promoted by the surfactant. The dissolution leads to an increase of retention capacity of the clay that can be multiplied by 4 or 5 in few weeks.

38522 **(NMRDI—2-74-4327) Flow characteristics and injectivity behavior of water-soluble polymers: Final report.** Martin, F.D. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Apr 1987. 145p. NTIS, PC A07/MF A01 - New Mexico Research and Development Institute, 1220 South St., Francis Drive, Santa Fe, NM 87501. File Number DE87900904.

The objective of this project was to determine the key properties of water-soluble polymers that affect injectivity of polymer solutions used in enhanced recovery processes. The project consisted of performing a thorough literature survey on this subject, followed by laboratory tests to assess various properties of polymer solutions. In the literature survey, laboratory and field projects were reviewed. Information from the literature survey on field projects and from experiments performed as part of this study points out that water quality is very important in the injectivity of polymer solutions. Specifically, if iron is introduced as a corrosion byproduct, the polymers can be crosslinked which can lead to severe plugging when the polymer solution is injected. For some polymers, procedures used for mixing solutions can be important. Higher solution viscosities may be obtained if emulsion polymers are inverted in a very fresh water prior to mixing with a brine water. Filterability and injectivity of some emulsion polymers are better when the polymers are dissolved in a fresher water. As expected, injectivity of xanthan gum polymers was better than for polyacrylamide polymers. For polyacrylamides, adsorption was higher on dolomite than on sandstone, but the adsorption on either

media was not affected greatly by anionic charge of the polymers. Injectivity of polymer solutions may be improved by pretreatment with certain solvents or chemicals. After a loss of injectivity caused by plugging from a polymer solution, selected chemicals can provide improvement in injectivity. 155 refs., 30 figs., 27 tabs.

38523 **(NP—7770146) Mechanisms in tenside flooding and the effects of dissolved gases in the oil phase.** Burkowsky, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1986. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770146.

After an introductory survey of phase stability and boundary surface stresses in oil-water tenside systems in tertiary oil production, the experimental equipment used in this work, such as PVT and flooding equipment and the measuring equipment (tensiometer) for the laboratory experiments are described. One degasified, one methane and one original gas saturated deposit were examined. The results are shown and discussed. By introducing basic parameters, a hypothesis was developed for the mechanism of the tenside flooding process in highly saline systems, which is valid regardless of the quality of the oil used.

38524 **(NP—7770149) Contribution to the displacement of miscible liquids in porous media, taking the differences in density and viscosity into account.** Bouhroum, A. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1985. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770149.

The different models for the analysis of the processes which have occurred were briefly explained and the different mechanisms, which act in the displacement of miscible liquids in porous media are discussed. The work examines the suitability of the dispersion equation for describing the displacement. The results of the investigations are shown and the parameters are described by introducing dimensionless coefficients.

0204 Processing

REFER ALSO TO CITATION(S) 39146

38525 **(FRNC-TH—2347) Researches on separation of saturated and aromatics followed by a moderated cracking of an heavy oil fraction.** Ammar Saeidi, S. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). 1984. 140p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752661.

Cracking of a distillation residue of a kirkuk crude (Iram) and saturated and aromatics fractions are studied. Separation of aromatics and saturated fractions is obtained by liquid phase chromatography. The liquid phase is cracked under hydrogen, nitrogen or helium pressure. Optimal conditions, depending on heavy oil treated, are a reaction temperature of 430 to 530/sup 0/C under hydrogen pressure and with a reaction time of few minutes. 25 refs.

38526 **(FRNC-TH—2402) Catalytic and structural properties of hydrorefining catalysts based on molybdenum and nickel.** Paulus, R. (Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 136p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752667.

The valorization of heavy products (distillation residues and heavy crudes) in petroleum refining is examined. Performance improvement of sulfide catalysts used in hydrorefining (for hydrogenation and elimination of heteroatoms) is studied. The catalytic system NiMo/γAl/sub 2/O/sub 3/ seems well adapted at the present time. Catalytic properties are highly dependent on the activation step (reduction-sulfidation) of the oxide precursor to obtain the sulfide catalyst which is the active form. This activation step is studied in detail in varied conditions. 114 refs.

38527 **(FRNC-TH—2408) Modelling of thermal behavior of oil heavy cuts. Pyrolysis of sulphur compounds with hydroaromatic diluents.** Abi-Khers, V. (Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 176p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752663.

Thermal treatment of asphalts and petroleum residues produces gases, coke and a liquid fraction that can be valorized. Products obtained depend on pyrolysis techniques, hydrogen donor diluents and sulfur compounds contained in the fossil fuel. Pyrolysis of asphalt extracted by pentane from Boscan (Venezuela) with hydrogen donor diluents is studied. Thermal behavior of aryland alkyl sulfides or disulfides between 300 and 500 /sup 0/C, the chemistry of thioaryl and thioalkyl radicals and corresponding thiols is examined. Influence of temperature concentration and hydroaromatic diluent is specified. Thermal behavior of sulfides and sulfones are compared. 133 refs.

38528 **(IFP—32-330) Study by electron microscopy and EXAFS of the mass and surface structure of small metal particles of metal-support epitaxy phenomena on supported monometallic catalysts.** Rosenberg, E. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). 20 Jul 1984. 260p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752665.

Supported metallic catalysts are widely used in the refining industry and petroleum chemistry. The catalytic system Pd/Al/sub 2/O /sub 3/ γ is used for selective hydrogenation of C/sub 3/-C/sub 4/ pyrolysis effluents. Industrial catalysts based on palladium deposited on γ aluminium oxide are characterized in this work. Afer a review of literature on morphology and structure of supported aggregates and on the system Pd/Al/sub 2/O/sub 3/ γ. At each elaboration step the metallic phase is characterized by electron microscopy, extended X-ray spectroscopy and reduction in programmed temperature. Mutual orientation between support and metal and epitaxy obtention are studied.

38529 **(NP—7770126) Hydropyrolysis of naphthenic model hydrocarbons and effects of O/sub 2/, CO, and H/sub 2/O on the hydropyrolysis of n-tetradecane.** Hieu Giangtoan. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemieingenieurwesen). 1 Jul 1983. 151p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770126.

Model experiments were carried out concerning the thermal hydrocracking (hydropyrolysis) of hydrocarbons. The first part of the programme comprised the hydropyrolysis of the pure naphthenic model hydrocarbons cyclohexane, ethyl cyclohexane, and hexahydroindane. Hydropyrolysis of naphthene starts, at a time of residue of 5 s and total pressures of 20 to 100 bar, shortly above 500/sup 0/C and becomes complete at around 700/sup 0/C. The main products are aliphatic C/sub 1/ to C/sub 3/ hydrocarbons and C/sub 6/ naphthenes. In the second part of the programme, the influence of different additives (e.g. CO, water vapour, O, and a mixture of CO and water vapour with and without a K/sub 2/CO/sub 3/ conversion catalyst) on the hydropyrolysis of n-tetradecane was investigated.

38530 **Phase equilibria in supercritical propane systems for separation of continuous oil mixtures.** Radosz, M.; Cotterman, R.L.; Prausnitz, J.M. (Exxon Research and Engineering Co., Annandale, NJ). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 731-737(Apr 1987).

Experimental and calculated phase equilibria are reported for two systems containing propane and petroleum-derived oil mixtures near 400 K and pressures to 55 bar; these conditions are close to critical. In the first system, the oil is rich in saturated hydrocarbons; in the second system, the oil is rich in aromatic hydrocarbons. For both oils, number-average molecular weights are in the range 300-350. Solubilities in two equilibrium phases, measured with a flow-cell apparatus, are correlated with the perturbed-hard-chain equation of state wherein the composition of the heavy hydrocarbon is described by a continuous distribution function. A simple procedure is proposed to derive a molecular-weight distribution from boiling-point data.

0205 Products And By-products

REFER ALSO TO CITATION(S) 38513, 39171

38531 **(AD-A—179800/8/XAB) High-density jet-fuel availability study. Phase 1. Refining industry survey. Interim report, 15 November 1985-11 August 1986.** Frederick, F.P. (Bonner and Moore Associates, Inc., Houston, TX (USA)). 30 Jan 1987. 59p. NTIS, PC A04/MF A01.

Survey of ten refining companies to explore production schemes, raw-materials processing costs and potential quantities of high-density jet fuel is summarized. Estimated regional and national production capabilities are presented along with estimated manufacturing costs. Access to potential feedstock samples is also discussed. Refining issues and consideration for further study are presented.

38532 **(IFP—32-427) Contribution to the separation of hydrocarbons from a C/sub 4/ cut by superfractionation or extractive distillation.** Ghotbi, C. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). 1984. 204p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752664.

For valorization of effluents from steamcracking or catalytic cracking the separation of C/sub 4/ olefin isomers by superfractionation or extractive distillation is studied. Thermodynamic principles are recalled. Then different models are tested and parameters of the NRTL model (Non Random Two Liquids) are determined using literature data on 13 binaries of the C/sub 4/ cut. Accuracy in parameter determination is very important for superfractionation. A calculation method for extractive distillation with total recycling is presented. Liquid-liquid-vapor equilibria in presence of dimethylformamide as solvent are studied for the C/sub 4/ cut and application is made for butenes separation by extractive distillation.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 39031, 39033

38533 **(DOE/EIA—0109(87/04)) Petroleum supply monthly, April 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Jun 1987. 110p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87012181.

Statistics are summarized for 1986, including an article on timeliness and accuracy of petroleum supply data. Appendices include district descriptions and maps. 12 figs., 33 tabs. (PSB)

38534 **(IFP—32-480) Cost and cost index of oil exploration and production.** Caulet, P. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Dec 1984. 292p. (In French). NTIS (US Sales Only), PC A13/MF A01. File Number DE87752660.

Exploration and development of a petroleum deposits are economically the most important for investments and expenses (nearly 70% of total investment in the world petroleum industry in 1981). Costs are analysed to follow their evolution and for a rapid estimation in function of technical and economical parameters concerning investment. Activities studied and their localisation are: onshore drilling in the USA, pipelines in the USA, exploration and fixed offshore platformes in the gulf of Mexico, in the gulf of Guinea and in the North Sea, development of onshore deposits in the USA and offshore deposits in the gulf of Guinea and North Sea.

0208 Waste Management

REFER ALSO TO CITATION(S) 38802

38535 **Waste hydrocarbon recycling.** Brinkman, D.W. New York, NY; American Institute of Chemical Engineers (1985). 14p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 119D.

This paper discusses two specific examples addressing the two largest categories: used lubricating oil and contaminated fuels. Waste hydrocarbon recycling is still not a common practice. Very few lube oil re-refiners of any size exist in the U.S. But many smaller recyclers and potential investors are interested. Once EPA has established the regulations so that everyone will know the rules by which they must operate, investment decisions can be made. Considering the resource, energy, and environmental conservation impacts, it is a bigger issue than one might imagine as he stares at the gallon of dirty liquid he has just drained from his car wondering what to do with this "waste."

0209 Environmental Aspects

38536 **(AD-A—179926/1/XAB) Operations and maintenance report on Air Force oil/water separators. Final report, September 1985-August 1986.** Kilroy, M.D. (Dynamac Corp., Panama City, FL (USA)). Oct 1986. 188p. NTIS MF A01.

Availability: Microfiche copies only.

This report is intended to provide general guidance for the routine operation and maintenance of oil/water separators. The report should help managers and operators to recognize and correct problems affecting the separation process of oil and water. The most common types of gravity separators used by the Air Force are discussed. Other topics include operation guidelines, flow measurements, maintenance service, waste disposal and regulations, sampling and testing, recordkeeping and spill-prevention measures.

38537 **(PB—87-190286/XAB) Review of cumulative impact-assessment literature and North Slope Borough development projects. Special report No. 5 (Final).** Denslow, S.; Goode, P.; Younger, D.; Feldman, M.; Braund, S. (Agricultural Research Service, Washington, DC (USA). Water Conservation Lab.). Feb 1985. 481p. NTIS, PC A21/MF A01.

Report on Social and Economic Studies Program, Alaska Outer Continental Shelf Region. Prepared in cooperation with Braund (Stephen R.) and Associates, Anchorage, AK., and Dames and Moore, Anchorage, AK.

The study reviews the environmental assessment literature to determine its potential applicability to assessment of the cumulative impacts of oil, gas, and other industrial and community development projects on the communities of the North Slope Borough. The review provides a set of six general approaches and several observations which could help Mineral Management Services (MMS) develop a new framework for subsequent cumulative impact analysis. Some of these approaches are similar to the current methods used by MMS. The report also describes 58 projects that may be included in future North Slope Borough cumulative impact assessments. Eight of these projects are oil projects that have already been found commercially viable. Another 23 projects are North Slope Borough capital improvement projects, which extend through 1989.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 38505

0230 Properties

REFER ALSO TO CITATION(S) 38692

38538 **(AEEW-R—2109) Modelling phase behaviour of petroleum fluids. A review of current methods.** Naylor, P. (UKAEA Atomic Energy Establishment, Winfrith). Aug 1986. 32p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The ability to predict the phase behaviour of petroleum fluids is highly desirable since it can save considerable time and ex-

pense during petroleum recovery. This paper reviews the methods which are currently used in the petroleum industry. Cubic equations of state are the most popular method of phase behaviour analysis and recommendations for their application to fluids containing many hydrocarbon components are described. Limitations of the current methods are highlighted and suggestions for further improvements are discussed.

38539 **(FRT—81-D-1252) Application of a new technique of separation to the analysis of asphaltenes.** Martin, M.; Reynaud, R. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1984. 46p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752681.

Thermal field flow fractionation is used for the separation of 3 asphaltene samples in 3 different solvents: anisol, cyclohexanone and toluene. Toluene is the better eluant. Influence of eluant flow rate on retention and peak broadening is studied. As polymers, asphaltenes migrate towards decreasing temperature under a thermal gradient. An important fractionation effect is evidenced. Fractions are studied by visible and ultraviolet spectrometry. Molecular mass distribution curve is determined, assuming that there is the same relationship between molecular mass and thermal diffusion factor than for polystyrenes. The use of polystyrene as a reference material for molecular mass determination of petroleum heavy fractions is proposed. 18 figs., 19 refs.

0250 Combustion

REFER ALSO TO CITATION(S) 39475

03 NATURAL GAS

REFER ALSO TO CITATION(S) 39142

0301 Reserves

REFER ALSO TO CITATION(S) 38505

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 38506, 38507, 39362, 39476

38540 **(DOE/MC/21179—2272) Rock matrix and fracture analysis of flow in western tight gas sands: Quarterly technical progress report, October-December 1986.** Morrow, N.R.; Buckley, J.S.; Brower, K.R.; Cather, S.M. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). 1986. Contract AC21-84MC21179. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006032.

The overall objective of this research is to show how gas can flow from the rock matrix to natural or induced fractures, and undergo commercial production. In this quarterly report, accomplishments are presented for the following tasks: (1) advanced core analysis; (2) flow along and across fractures; (3) chemical alteration; and (4) effect of water on gas production. Cores are being tested from the fluvial, coastal, and paludal zones of the Mesaverde. Properties measured include permeability, porosity and for selected samples, water adsorption and desorption isotherms. Some of the findings are: production from some low permeability gas sands is much higher than would be expected from properties of the rock matrix as determined by core analysis; the cores show that by far the majority of fractures are filled with calcite cement; the effects of six chemical treatments on rock properties are presented for a fluvial sample; water and brine permeabilities and desorption-adsorption isotherms are presented for both preserved and oven-dried plugs, and results are compared. 15 figs., 2 tabs.

38541 **(DOE/MC/21181—1950-Vol.8) Geological evolution and analysis of confirmed or suspected gas hydrate localities: Volume 8, Basin analysis, formation and stability of gas hydrates in the northern California offshore.** Krason, J.; Ciesnik, M.S. (Geoexplorers International, Inc., Denver, CO (USA)). Jun 1986. Contract AC21-84MC21181. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001078.

This report presents a geological description of the offshore margin of northern California, including regional and local structural settings, geomorphology, geological history, stratigraphy, and physical properties. It provides the necessary regional and geological background for more in-depth research of the area. Detailed discussion of bottom simulating acoustic reflectors, sediment acoustic properties, and distribution of hydrates within the sediments are also included in this report. The formation and stabilization of gas hydrates in sediments are considered in terms of phase relations, nucleation, and crystallization constraints, gas solubility, pore fluid chemistry, inorganic diagenesis, and sediment organic content. Together with a depositional analysis of the area, this report is a better understanding of the thermal evolution of the locality. It should lead to an assessment of the potential for both biogenic and thermogenic hydrocarbon generation. 41 refs., 23 figs., 2 tabs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 38513, 38540

38542 (CONF-8610274—Absts., pp 8) **Design criteria for gas compressors and operational experience in gas extraction from largely exhausted deposits.** Petraschka, J. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

0304 Products And By-products

REFER ALSO TO CITATION(S) 39171

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 39031

38543 (CONF-8610274—Absts., pp 6) **Contribution of natural gas for covering the needs of primary energy in Western Europe - prospects to the year 2000.** Fehringer, A. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38544 **(DOE/EIA—0130(87/04)) Natural gas monthly, April 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 29 Jun 1987. 145p. NTIS, PC A07/MF A01 - GPA; 1; GPO Dep. File Number DE87012643.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1981 through April 1987 with monthly data for the most recent three years. Some data are also given by State or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Featured article for this month is "Contract Provisions Covering Production of new Gas." 6 figs., 38 tabs.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 38537

0309 Artificial Stimulation

38545 **(NP—7770155) Modern equipment for FRAC treatment.** Grossmann, U.; Marx, C. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1983. 163p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770155.

The work gives a comprehensive survey of the equipment required for carrying out FRAC treatment: - tanks and silos - low pressure and high pressure manifold systems - blenders - high pressure pumps including intensifiers - control and measurement devices - additional devices. The construction and method of operation of the individual components is described in detail. The great use of equipment in large FRAC treatments (MHF) is shown with the example of the stimulation of the SOeHLINGEN Z 4 borehole.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 38505

38546 **(FRNC-TH—2424) Optimization of a cryogenic rotating connecting piece for transfer of liquefied natural gas.** Deriquehem, B. (Paris-12 Univ., 94 - Creteil (France)). 1984. 123p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752198.

Exploitation of offshore natural gas deposits requires the conception of a new technology for connecting the platform to the tanker. The solution retained is a deformable parallelogram, the different tubes of which are connected by cryogenic swivel. A rheoelectric analogy allows, in steady state, the determination of temperature in the different components. Mechanical and thermal behavior of the prototype in transients or steady state, during liquefied natural gas transfer, are analysed on a simulator. Different applications are presented. 17 refs.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

38547 (UCRL—52000-87-5, pp 21-30) **Modeling the generation of oil and gas.** 1987. NTIS, PC A03/MF A01. File Number DE87010851.

In Energy and Technology Review, May 1987.

As easily accessible petroleum deposits are depleted and deeper, more obscure deposits must be located, exploration geologists will need more and more information about the fundamental processes of oil and gas formation. We are developing computer models of geological processes that may eventually be used to locate productive drilling sites. We have modeled the time and temperature history of kerogen-rich Green River shale from geophysical data on oil fields in Utah's Uinta Basin to predict amounts of oil or gas at a given depth, changes in compositional characteristics with time and temperature, and the maturation of oil. Our work integrates the modeling of thermal history with chemical kinetic modeling.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 38529, 38539

38548 **Fluidized bed pyrolysis of tar sand: The influence of process variables on product distribution and liquid product quality.** Dorius, J.C.; Hanson, F.V.; Oblad, A.G. New York, NY; American Institute of Chemical Engineers (1985). 39p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 31F.

The influence of process operating variables on the product distribution and yields for the pyrolysis of bitumen impregnated sandstone in a fluidized bed reactor has been investigated. The quality of the liquid products has also been determined and related to the process operating variables. The process variables investigated included pyrolysis reactor temperature, sand retention time in the pyrolysis zone of the reactor and the fluidizing gas velocity. The range of variables were as follows: temperature 723-973 κ (450-700°C), feed sand retention time 15-35 minutes and fluidizing gas velocity 1-4 times the minimum fluidization velocity. The reactor pressure and feed sand particle size were constant in all experiments: the reactor pressure was maintained at one atmosphere and the average feed sand particle size was 359 microns.

0405 Properties And Composition

38549 **(UCID—21093) Mechanical properties of heavy oil-sand and shale as a function of pressure and temperature.** Blair, S.C.; Sweeney, J.J.; Ralph, W.R.; Ruddle, D.G. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012699.

Laboratory tests were conducted to determine the mechanical properties of oil-sand and shale samples from the Faja region of Venezuela at elevated temperature and pressure. Results describe pressure-volume (PV) behavior at temperatures of 23 and 125°C; the effect of mechanical disturbance on PV behavior; equation-of-state (EOS) at temperatures of 23, 125, and 250°C and effective pressures to 150 MPa; and creep/compaction behavior at temperatures of 23 and 125°C. Data from PV tests on oil-sand show that increasing temperature from 23 to 125°C had very little effect on this material. Mechanical disturbance of oil-sand prior to PV testing lowered values of K. The compressive strength of oil-sand increased as effective (P/sub E/) was raised and at both temperatures, samples tested at equivalent P/sub E/ had similar strengths. Compressive strength of oil-sand seems to be controlled by the drainage of pore fluid during axial deformation. Nearly all oil-sand samples exhibited strain-hardening. PV tests conducted on shale show that increasing temperature from 23 to 125°C reduced values of K one third. Mechanical disturbance significantly affected the PV response of shale samples due to the friable nature of the material. Data for shale samples tested in triaxial compression show that ultimate stress increases with increasing pressure and increasing temperature. Results of long-term creep compaction tests show a linear change in sample volume as a function of the log of time and that the rate of volume change with time was larger at 125°C than at 23°C for both oil-sand and shale. 4 refs., 31 figs., 6 tabs.

38550 **Chemical factors affecting insolubles formation in shale-derived diesel fuel.** Beal, E.J.; Cooney, J.V.; Hazlett, R.N. (Naval Research Lab., Washington, DC 20375-5000). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 530-537(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

In an effort to define the stability of shale-derived diesel fuel, the authors have conducted gravimetric accelerated storage stability tests at 43 and 80°C using three model nitrogen compounds, 2-methylpyridine, 2,6-dimethylquinoline and dodecahydrocarbazole, as dopants in an otherwise stable shale diesel fuel. Also, information about potential interactive effects has been defined for these three model nitrogen compounds in the stable fuel in the presence of a second model dopant (a hydroperocide, organic acid or base).

0407 Health And Safety

38551 **Health and environmental concerns of oil shale technology.** New York, NY; American Institute of Chemical Engineers (1985). 17p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).
Technical Paper 48C.

The 1984 risk analysis completed the methodology and the initial estimates for potential health and environmental risks of a steady-state million BPD oil shale industry. The effort was based on existing and novel approaches. The methodology included the use of uncertainty factors to assess and prioritize research needs to reduce the important uncertainties. The use of the analysis for aid in research management is a dynamic and interactive process. As new information becomes available, the risk analysis should be iterated and updated as part of the research prioritization process to provide decision makers with a scientific base upon which cost effective research management decisions could be made.

0409 Waste Research And Management

38552 **Polymer flotation and activated carbon adsorption treatment for in situ tar sand process water.** Mc Ternan, W.F.; Kocornik, D.J.; Nolan, B.T.; Blanton, W.E.; Boardman, G.D. New York, NY; American Institute of Chemical Engineers (1985). 13p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).
Technical Paper 48D.

Tar sand deposits in the United States are estimated to exceed thirty billion barrels, and offer long term potential for satisfying future energy needs. At present there is no commercial scale tar sand extraction industry in the United States, although several bench and pilot scale research projects have been completed. Three of the larger field scale experiments were completed by the Department of Energy (DOE) at a site near Vernal, Utah. The first two of these efforts involved in situ combustion while the third used steam drive. This paper reviews some of the flotation configurations which were used to generate a large (350 L) volume of treated effluent as well as describing some toxicology and analytical chemistry protocols used to characterize these fluids. Additional emphasis is placed upon a series of activated carbon adsorption experiments undertaken to detoxify the flotation effluents.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 38551

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 39293

38553 **(INIS-BR—612) Uranium exploration methods used by NUCLEBRAS.** Santos, L.C.S. dos. (International Atomic Energy Agency, Vienna (Austria)). 1985. 47p. (CONF-8504264—6). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702450.

From Interregional training course on exploration drilling and ore reserve estimation for uranium deposits; Pocos de Caldas, Brazil (22 Apr 1985).

The main methods used by geologists of NUCLEBRAS in uranium prospecting are presented and described. Severals geologic areas were evaluated based on geologic environments and short local surveys. The efficiency of methods were proved by the results. The steps for uranium prospecting carried out are: geological reconnaissances, aereal surveys, photogeological mappings, geochemical surveys, geological profiles, radiometric surveys, geological mappings, drillings and chemical analysis. (M.C.K.).

38554 **(INIS-BR—613) Brazilian uranium deposits.** Santos, L.C.S. dos. (International Atomic Energy Agency, Vienna (Austria)). 1985. 22p. (CONF-8504264—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702451.

From Interregional training course on exploration drilling and ore reserve estimation for uranium deposits; Pocos de Caldas, Brazil (22 Apr 1985).

Estimates of uranium reserves carried out in Figueira, Itataia, Lagoa Real and Espinharas, in Brazil are presented. The samples testing allowed to know geological structures, and the characteristics of uranium mineralization. (M.C.F.).

38555 **(INIS-BR—631) Uranium accurrence in the Cristalino River, South of Para, Brazil.** Andrade, S.M. de; Ribeiro, E.; Camarco, P.E.N.; Puppin, C.; Santos Filho, J.L. dos. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—5-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702466.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38556 **(INIS-BR—632) Phosphorus-uranium mine in Itataia, Brazil - Influence of alteration and argilization in the process of physical beneficiation of mineralized lithologies.** Rosa, C.V. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702467.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38557 **(INIS-BR—633) Itataia mine, Brazil - structural sectioning of pit for ditch until the level of 480 meters.** Mendonca, J.C.G.S. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—7-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702468.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38558 **(INIS-BR—634) Itataia mine, Brazil - Characterization of massif for alteration - argillization and estimation of volume of materials into the ditch.** Alcantara e Silva, J.R. de. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—8-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702469.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38559 **(INIS-BR—636) Distribution of U and Th in acid volcanic rocks of the Parana basin.** Marques, L.S.; Molina, E.C.; Melfi, A.J.; Vasconcellos, M.B.A. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—10-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702471.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38560 **(INIS-BR—637) Concentrations of U, Th and K in rocks of Pocos de Caldas alkaline massif, in Brazil, determined by gamma spectrometry.** Rocha, E.B.; Fujimori, K.; Ulbrich, H.H. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—11-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702472.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38561 **(INIS-BR—638) Uranium mineralization associated with metasomatic alteration sequential process: Lagoa Real, Bahia, Brazil.** Lobato, L.M. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—12-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702473.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38562 **(INIS-BR—639) Lithologic characterization and distribution of uranium ores in field metasediments of the Cristalino River Project - South of Para State, Brazil.** Salas, H.T.; Murta, R.L.L. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—13-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702474.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38563 **(INIS-BR—644) Estimation of uranium content from gamma register obtained by boreholes.** Juliao, B. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—18-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702479.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

38564 **Kinetic study of pyrite oxidation in basic carbonate solutions.** Guilinger, T.R.; Schechter, R.S.; Lake, L.W. (Sandia National Labs., Albuquerque, NM). *Industrial and Engineering Chemistry Research;* 26: No. 4, 824-829(Apr 1987).

The general goal of this experimental study was to find ways to control the unwanted oxidation of pyrite during the in situ leaching of uranium ores. The authors investigated the effect of particle size, leaching pH, flow rate, total carbonate concentration, and cation type of column leaching rates. The work appears to be the first dealing with pyrite leaching in test columns at high pH in which the identity and percentages of the various eluted sulfur compounds was measured. The most interesting of the experimental observations was the ultimate ceasing of the pyrite reaction when using an ammonia leachant.

0504 Feed Processing

38565 **(INIS-mf—10894) Uranium extraction from phosphoric acid.** Lounis, A. (Commissariat aux Energies Nouvelles, Algiers (Algeria). Centre de Developpement des Techniques de Base). May 1983. 70p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702486.

A study has been carried out for the extraction of uranium from phosphoric acid produced in Algeria. First of all, the Algerian phosphoric acid produced by SONATRACH has been characterised. This study helped the authors to synthesize a phosphoric acid that enabled then to pass from laboratory tests to pilot scale tests. Examined extraction and stripping parameters have been examined: diluent, DZEPHA/TOPO ratio and oxidising agent. The laboratory experiments enabled the authors to set the optimum condition for the choice of diluent, extractant concentration, ratio of the synergic mixture, oxidant concentration, redox potential. The equilibrium isotherms lead to the determination of the number of theoretical stages for the uranium extraction and stripping of uranium, then the extraction from phosphoric acid has been verified on a pilot scale (using a mixer-settler).

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 38672

38566 **(K/OA—6076) Overview of uranium enrichment technologies: Technical and economic perspective.** Hoglund, R.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1987. Contract AC05-84OT21400. 33p. (CONF-8705121—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009814.

From Atomic Industrial Forum international conference; San Francisco, CA, USA (26 May 1987).

This report discusses some thoughts and unclassified information on several enrichment processes which are receiving attention today. These are gas centrifuge, the aerodynamic processes, chemical and ion exchange, and the laser processes. Process performance is emphasized, and factors are identified which are strong drivers of separation performance and major determiners of costs.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 38832, 39334

38567 **(DOE/DP—0041) Nuclear Materials Production: Primer.** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Management Systems Labs.). Jun 1987. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011614.

This document provides a general introduction to DOE's Office of Nuclear Materials Production, which is responsible for managing the production and recovery of nuclear materials for national defense. (PSB)

38568 **(LBL—23630) Determination of laser-evaporated uranium dioxide by neutron activation analysis.** Allred, R. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012877.

Safety analyses of nuclear reactors require information about the loss of fuel which may occur at high temperatures. In this study, the surface of a uranium dioxide target was heated rapidly by a laser. The uranium surface was vaporized into a vacuum. The uranium bearing species condensed on a graphite disk placed in the pathway of the expanding uranium vapor. Scanning electron microscopy and X-ray analysis showed very little droplet ejection directly from the laser target surface. Neutron activation analysis was used to measure the amount of uranium deposited. The surface temperature was measured by a fast-response automatic optical pyrometer. The maximum surface temperature ranged from 2400 to 3700°K. The Hertz-Langmuir formula, in conjunction with the measured surface temperature transient, was used to calculate the theoretical amount of uranium deposited. There was good agreement between theory and experiment above the melting point of 3120°K. Below the melting point much more uranium was collected than was expected theoretically. This was attributed to oxidation of the surface. 29 refs., 16 figs., 7 tabs.

38569 **The characterization of selected nuclear fuel cycle materials by ICP-AES.** Huff, E.A. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). pp 155 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Current reactor research at the Argonne National Laboratory centers on nuclear fuels development that addresses nonproliferation and cost-effectiveness issues. Uranium was adsorbed by the organic phase and the impurities were eluted by nitric acid. After evaporation and volume adjustment, the trace metals were determined by ICP-AES. Excellent recoveries were obtained using this technique.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 38669, 38878

38570 **(DP-MS—87-12) Online analysis by a fiber-optic diode array spectrophotometer.** Van Hare, D.R.; Prather, W.S.; O'Rourke, P.E. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 14p. (CONF-870661—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012384.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

An online photometric analyzer has been developed which can make remote measurements over the 350 to 900 nm region at distances of up to 100 feet. The analyzer consists of a commercially available diode array spectrophotometer interfaced to a fiber-optic multiplexer to allow online monitoring of up to ten locations sequentially. The development of the fiber-optic interface is discussed and data from several online applications are presented to demonstrate the capabilities of the measurement system.

38571 (EGG-ME—7679) Special study for the manual transfer of process samples from CPP [Chemical Processing Plant] 601 to RAL [Remote Analytical Laboratory]. Marts, D.J. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1987. Contract AC07-76ID01570. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012430.

A study of alternate methods to manually transport radioactive samples from their glove boxes to the Remote Analytical Laboratory (RAL) was conducted at the Idaho National Engineering Laboratory. The study was performed to mitigate the effects of a potential loss of sampling capabilities that could take place if a malfunction in the Pneumatic Transfer System (PTS) occurred. Samples are required to be taken from the cell glove boxes and analyzed at the RAL regardless of the operational status of the PTS. This paper documents the conclusions of the study and how a decision was reached that determined the best handling scenarios for manually transporting 15 mL vials of liquid process samples from the K, W, U, WG, or WH cell glove boxes in the Chemical Processing Plant (CPP) 601 to the RAL. This study of methods to manually remove the samples from the glove boxes, package them for safe shipment, transport them by the safest route, receive them at the RAL, and safely unload them was conducted by EG & G Idaho, Inc., for Westinghouse Idaho Nuclear Company as part of the Glove Box Sampling and Transfer System Project for the Fuel Processing Facilities Upgrade, Task 10, Subtask 2. The study focused on the safest and most reliable scenarios that could be implemented using existing equipment. Hardware modifications and new hardware proposals were identified, and their impact on the handling scenario has been evaluated. A conclusion was reached that by utilizing the existing facility hardware, these samples can be safely transported manually from the sample stations in CPP 601 to the RAL, and that additional hardware could facilitate the transportation process even further.

38572 (INIS-mf—10279) Studies on the primary and secondary residues from the dissolution of high-burnup nuclear fuels. Schmid, M. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 14 Feb 1986. 232p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-10206.

To clarify the composition of residues from the dissolution of high-burnup nuclear fuels a sample with a burnup of 4.5 GWd and a two year cooling period was studied with the help of REM-EDX. In a parallel experiment an inactive simulated solution was subjected to a similar chemical treatment. The residues which resulted from this were analysed analogously. As a result the chemistry of the following compounds in HNO/sub 3/ were studied: MoO/sub 3/, ZrMo/sub 2/O/sub 5/(OH)/sub 2/x2H/sub 2/O, the oxide of antimony as well as Sb/sub 4/O/sub 4/(OH)/sub 2/(NO/sub 3/)/sub 2/, PdO.xH/sub 2/O, Ag/sub 2/Se, Ag/sub 2/Te, and CsTcO/sub 4/. Of special interest here were the solubility and precipitation formation of these compounds as well as the influence of a high (ca. 1 mol/l) concentration of uranium on these characteristics. With high radiation doses to the simulated solution a radiolytical reduction of Pd/sup 2+/ was established and was studied more closely with pure Pd(NO/sub 3/)/sub 2/ solutions. In primary dissolution residues the presence of the radionuclides Ru-106, Ag-110m, Sb-125, Cs-134, and Cs-137 was γ-spectrometrically proven. The residue was made up primarily of an element combination of Mo and Ru. Other components such as Rh, Pd and Tc appear in an alloy as the so-called ϵ phase, which has to be present already in the fuel, because this phase was not exhibited in the similarly handled simulator. Zirconium molybdate was not identified in the real feed slurries, but was definitely present in the precipitation of the simulated feed solution. The analysis of the primary residues also showed pure zirconium particles, presumably from the zirconium alloy of the fuel cans, as well as undissolved fuel particles. The precipitation from the fuel solution was made up of agglomerates of the smallest particles of the ϵ phase, upon which silver halogenides were crystallized. Radiochemically reduced Pd was also found.

38573 (INIS-mf—10682) Study on the transport behavior of uranyl nitrate in aqueous and non-aqueous systems. A contribution to the optimization of reprocessing of nuclear fuels. Roesel, B. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Chemie). 18 Jul 1985. 145p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10154.

The analytical ultracentrifuge has proven itself through diffusion measurements to be well suited for studying radioactive compounds. In the framework of this paper the extent to which the UV and schlieren optics of an analytical ultracentrifuge can be used for extraction-kinetic tests was tested. With this method there is also the possibility of determining the distribution coefficients right at the phase boundary. The results show the good possibility of application of the absorption and schlieren optics to the study of the transport behavior of uranyl nitrate in practice oriented solutions.

38574 (KFK—4219) Raman spectrometric determination of Pu(VI) and Pu(V) in nitric acid solutions. Gantner, E.; Freudenberger, M.; Steinert, D.; Ache, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Mar 1987. 31p. (In German). (PWA—107/86). NTIS, PC E07; Available from NTIS as TIB/B87-08669.

The determination of Pu(VI) in nitric acid solutions by spontaneous Laser Raman Spectrometry (LRS) was investigated and a calibration curve was established using U(VI) as internal standard. In addition, the concentrations of Pu(VI) and Pu(V) as a function of time were measured by this method in Pu(VI) solutions of different acidity containing H/sub 2/O/sub 2/ as the reducing agent. In solutions which are intensely coloured by the presence of Ru(NO) complexes Pu(VI) can also be determined by LRS using a Kr/sup +/ laser as excitation source. In future experiments, the study of the Pu(IV)-interaction with Ru using LRS and spectrophotometry as analytical techniques is therefore intended.

38575 (LA—10999) The effect of fluoride and aluminum on the anion exchange of plutonium from nitric acid. Marsh, S.F. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MFA01; GPO Dep. File Number DE870112[illegible]9.

Anion exchange in nitric acid is a prominent aqueous process used to recover and purify plutonium from impure nuclear materials. This process is sensitive to fluoride ion, which complexes plutonium in competition with the anionic nitrato complex that is strongly sorbed on the anion exchange column. Fluoride interference traditionally has been counteracted by adding a masking agent, such as aluminum, that forms competing complexes with fluoride. The interfering effect of fluoride is known to be a function not only of the fluoride-to-aluminum ratio but also of the fluoride-to-plutonium ratio. This report summarizes a Los Alamos study of the effect of 25 fluoride-aluminum-plutonium conmbinations on the anion exchange sorption of plutonium. Five aluminum-to-plutonium ratios ranging from 0.10 to 10 were each evaluated at five fluoride-to-aluminum ratios that ranged from 0 to 6. The fluoride-to-plutonium ratio has a greater influence on plutonium sorption than does the fluoride-to-aluminum ratio. Aluminum was less effective as a masking agent than had been assumed, because measurable fluoride interference occurred at all levels of added aluminum.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 38678, 39373, 39374, 39377, 39378, 39379, 39380, 39382, 39383, 39443, 39444

38576 (NUREG/BR—0111) Transporting spent fuel: Protection provided against severe highway and railroad accidents. Lahs, W.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Mar 1987. 32p. NTIS, PC A03/MF A01 - GPO. File Number TI87900917.

This report summarizes the results of a study conducted for the Nuclear Regulatory Commission (NRC) to determine the level of safety provided during shipments of spent fuel from US commercial nuclear power plants. The study focuses on the protection provided for shipments that may be involved in truck or railroad accidents. During shipment, the cask and the form and structure of the spent fuel being shipped provide the primary physical means for containing radioactivity and for limiting radiation levels outside the cask. These functions must be maintained at acceptable levels even

under the wide range of forces the cask and fuel could be subjected to during an accident. Spent fuel shipments are regulated by both the Department of Transportation (DOT) and the NRC. The NRC evaluates and certifies the design of the shipping casks used to transport spent fuel, while DOT regulates vehicles and drivers. Current NRC regulations require that shipping casks meet certain performance standards. The performance standards include normal operating conditions and hypothetical accident conditions a cask must be capable of withstanding without exceeding specified acceptance criteria that (1) limit releases of radioactive material and radiation levels outside the cask and (2) assure that the spent fuel will remain subcritical (that is will not undergo a self-sustaining nuclear reaction). The study, conducted by Lawrence Livermore National Laboratory (LLNL), began with an assessment of the possible mechanical and/or thermal forces generated by actual truck and railroad transportation accidents. The magnitudes of forces from actual accidents were compared with forces attributed to the "regulatory-defined" hypothetical accident conditions.

38577 **(ORNL/Sub—87-38435C/1&28) Functions of the cask maintenance facility: A white paper.** (H and R Technical Associates, Inc., Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA)). 21 Jul 1987. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012294.

The shipping cask systems are the mobile components of the transportation system, designed to safely transport spent nuclear fuel between different facilities under both normal and accident conditions. The cask system will consist of the heavily shielded cask, the cask transport vehicle (truck trailer or railcar), and any associated ancillary equipment (covers, impact limiters, lifting devices, etc.). The cask and certain parts of the cask system must be operated within the limits imposed by a certificate of compliance (COC) granted by the Nuclear Regulatory Commission (NRC). Each cask system must transport spent fuel safely during the life of the system. To maintain the operational effectiveness and safety of the cask systems, a cask maintenance facility (CMF) will be included as an integral part of the transportation system. The planning activity of the transportation system and the design effort of the CMF require that the functions to be performed by the CMF be explicitly defined. The purpose of this paper is to (1) define the potential transportation system functions to be performed at the CMF; (2) examine the impact of this functional definition on the overall transportation system; (3) identify any unresolved issues concerning the interaction of the CMF with other elements of the transportation system; and (4) make recommendations to resolve any unresolved issues so that decisions can be made early in the transportation system planning process.

38578 **(SAND—87-1744C) Applying consensus standards to cask development.** Leatham, J.; Abbott, D.G.; Warrant, M.M. (Sandia National Labs., Albuquerque, NM (USA); EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870713—30). NTIS, PC A02. File Number DE87012732.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Department of Energy's (DOE's) Office of Civilian Radioactive Waste Management is procuring cask systems for transporting commercial spent nuclear fuel and is encouraging development of innovative cask designs and materials to improve system efficiency. New designs and innovative materials require that consensus standards be established so that cask designers and regulators have criteria for determining acceptability. Recent DOE experience in certifying three spent fuel shipping casks, NUPAC-125B, TN-BRP, and TN-REG, is discussed. Certification of the NUPAC-125B was expedited because it was made of conventional American Society for Testing and Materials (ASTM) materials and complied with the American Society of Mechanical Engineers (ASME) Code and Nuclear Regulatory Commission Regulatory Guides. The TN-BRP and TN-REG cask designs are still being reviewed because baskets included in the casks are made of borated stainless steel, which has no ASTM Specification or ASME Code approval. The process of developing and approving consensus standards is discussed, including the role of ANSI and ANSI N14. Specific procedures for ASTM and ASME are described. A draft specification or standard must be prepared and then approved by the appropriate body. For new material applications to the ASME Code, an existing ASTM Specification is needed. These processes may require several years. The status of activities currently in progress to develop consensus standards for spent fuel casks is discussed, including (1) ASME NUPAC, and (2) ASTM Specifications for ductile cast iron and borated stainless steel.

38579 **Commercial waste programme in the United States of America: A major application of the IAEA Regulations in years to come.** Hilley, J.R. (Department of Energy, Washington, DC, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Consistent regulations that are consistently applied are of fundamental importance to a sound regulatory programme, which is the cornerstone for maintaining a safe and efficient transportation system. The Office of Civilian Radioactive Waste Management (OCRWM) within the United States Department of Energy seeks to maintain this attitude toward regulations in preparing to build and operate potentially the largest spent fuel and high level waste cask fleet in the world. Both the technical and institutional elements of the transportation system development programme are directed toward a goal of promoting regulatory consistency. The success of the International Atomic Energy Agency serves as encouragement to the OCRWM. 5 refs, 2 figs.

38580 **Worldwide application of IAEA Safety Series No. 6: Regulations for the Safe Transport of Radioactive Material, 1985 edition.** Rosen, M.; Pope, R.B.; Koponen, H.; Rawl, R.R. (International Atomic Energy Agency, Vienna, Austria. Div. of Nuclear Safety; Oak Ridge National Lab., TN, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The International Atomic Energy Agency has recently issued the 1985 Edition of Safety Series No. 6. The changes made in the Regulations, the plans of Member States and international organizations for adoption and the Agency's own plans for future revisions of these Regulations are reviewed. 1 ref, 4 tabs.

38581 **Standard for barge transport of Type B quantities of radioactive materials.** Jones, R.H.; Wilmot, E.L. (Hazardous Material Systems, Los Gatos, CA, USA; Department of Energy, Washington, DC, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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Although barge transportation plays an important role in the general commerce of the United States of America, only two radioactive material shipments have been completed. Despite the underutilization of the past, barge transportation is being considered by the Office of Civilian Radioactive Waste Management of the United States Department of Energy (DOE) as a viable option to augment land modes for the transport of commercial spent fuel and high level wastes. Barges appear to have sufficient potential as a competitive mode for several circumstances to warrant further investigation. The DOE will be relying on a standard for barge transportation of radioactive material which has been issued recently by the American National Standards Institute. The Standard is written particularly for large amounts of radioactivity that will be carried in Type B packagings. Its issuance prior to an immediate need will

aid in fostering public confidence that radioactive material shipments by barge can be accomplished in a safe and efficient manner. 1 ref.

38582 **Type A packaging compliance.** Edling, D.A.; Rawl, R.R. (Monsanto Research Corp., Miamisburg, OH, USA. Mound Facility; Oak Ridge National Lab., TN, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Recent changes in US transport regulations involved updating requirements relative to Type A packages in order to be consistent with the 1973 Edition of IAEA Safety Series No. 6. As a result, a study was carried out to assess the compliance of existing packages with the new requirements. General areas of consideration dealt with in the study included (1) the basic concept of a 'performance package', (2) the 'authorized contents' of packagings and the effects that different types of contents can have on the ability of a package to meet the required performance tests, (3) the quality control/quality assurance requirements necessary to assure compliance, particularly with respect to reuse. Specific questions dealt with included the following. (a) How does one simulate, as closely as practicable, the expected normal radioactive contents? (b) What is 'loss of contents'? (c) How many packagings of any one type need to be tested? (d) How does one evaluate the prevention of any significant increase in the radiation levels recorded at the external surfaces? (e) How does one evaluate the Type A test for a filtered packaging? 4 refs, 1 tab.

38583 **Legal, political and operational elements involved in the transport of Brookhaven spent nuclear fuel in the USA.** Garrison, R.F.; Kinne, G.C. (Department of Energy, Washington, DC, USA; Brookhaven National Lab., Upton, NY, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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In the United States of America, as in many other countries, the shipping of radioactive materials is a difficult task. One of the major problems is the issue of perception versus reality, with significant emotional and political overtones attached to it. Such was the case with a United States Department of Energy (DOE) fuel movement project for which nine years were needed in order to resolve complex legal issues. This included State, local and Federal regulatory issues, problems with package certification, risk assessments and a host of political and administrative issues. Although the DOE had been moving fuel from Brookhaven National Laboratory since 1962, the City of New York was successful in stopping these shipments from 1976 to 1985. Resolution of the problem included lawsuits, rulemaking by the Department of Transportation (DOT) and, finally, a final review by the Supreme Court of the United States of America.

38584 **Standard problem exercise to validate criticality codes for large arrays of packages of fissile materials.** Whitesides, G.E.; Stephens, M.E. (Oak Ridge National Lab., TN, USA; Nuclear Energy Agency, 75 - Paris, France. Nuclear Safety Div.). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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A study has been conducted by a Working Group under the auspices of the Organisation for Economic Co-operation and Development, Committee on the Safety of Nuclear Installations that examined computational methods used to compute k/sub eff/ for large >= 5/sup 3/ arrays of fissile material (in which each unit is a substantial fraction of a critical mass). Five fissile materials that might typically be transported were used in the study. The 'packages' used for this exercise were simplified to allow studies unperturbed by the variety of structural materials which would exist in an actual package. The only material present other than the fissile material was a variation in the moderator (water) surrounding the fissile material. Consistent results were obtained from calculations using several computational methods. That is, when the bias demonstrated by each method for actual critical experiments was used to 'correct' the results obtained for systems for which there were no experimental data, there was good agreement between the methods. Two major areas of concern were raised by this exercise. First, the lack of experimental data for arrays with size greater than 5/sup 3/ limits validation for large systems. Second, there is a distinct possibility that the commingling of two shipments of unlike units could result in a reduction in safety margins. Additional experiments and calculations will be required to satisfactorily resolve the remaining questions regarding the safe transport of large arrays of fissile materials. 1 tab.

38585 **Quality assurance topical report - International co-operation for manufacturing of nuclear packages.** Anderson, R.; Bonifacio, A.; Kingsley, K.; Bittner, R.; Ankrum, G.T.; Wieser, K.E. (General Nuclear Systems, Inc., Avon, CT, USA; Gesellschaft fuer Nuklearservice, Essen, Germany, F.R.; Nuclear Regulatory Commission, Washington, DC, USA; Bundesanstalt fuer Materialpruefung, Berlin, Germany, F.R.). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The paper addresses the manufacturing quality assurance (QA) concerns associated with fabrication of radioactive material packaging in one country for use in another. A case study is discussed which shows a method of implementation that has been successfully practised for casks fabricated in the Federal Republic of Germany (FRG) for use in the USA. The casks utilized are the Castor series, which are fabricated in the FRG from ductile cast iron. Although international efforts have helped to standardize QA measures, detailed implementation can vary from country to country. A means of co-ordinating requirements between countries was required. The vehicle used to accomplish this was the Quality Assurance Topical Report (QATR), which is an administrative QA document that clearly defines the roles and responsibilities of all affected organizations. The close correlation of requirements is documented in the QATR. In addition, a programme is described which permits the USA competent authority to depend on the FRG authority for inspection and enforcement procedures. It is of great importance that the fabrication and inspection of any component important to safety be properly controlled and documented. The USA requirements for these QA measures are enforced by the Nuclear Regulatory Commission (NRC). Enforcement of applicable regulations in the FRG is the responsibility of the competent authority, Bundesanstalt fuer Materialpruefung (BAM). As a part of the development of this QATR, NRC and BAM representatives met to establish a mutual understanding of QA. As a result, the QATR concept has been approved by both BAM and the NRC. A problem with manufacturing equipment in a foreign country is the need to periodically send company representatives to witness hold points and to review manufacturing records. The methods described in the QATR provide a practical and workable alternative by permitting the BAM to serve as the purchaser (or utility) agent. 1 fig. (Abstract Truncated)

38586 **DOE/PNC joint programme on transportation technology.** Kubo, M.; Kajitani, M.; Seya, M.; Yoshimura, H.R.; Moya, J.L.; May, R.A.; Huerta, M.; Stenberg, D.R. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan; Sandia National Labs., Albuquerque, NM, USA; Southwest Engineering Associates, Albuquerque, NM, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The paper summarizes the work performed in a co-operative programme on transportation technology between the US Department of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. This work was performed at Sandia National Laboratories (SNL) in Albuquerque, New Mexico. The joint programme emphasized the safety analysis for truck transportation of special nuclear materials (SNM) in Japan. Tasks included structural analyses and testing, thermal testing, leak rate studies and tests, and transportation risk assessments. The paper presents the results of full scale structural and thermal tests conducted on a PNC developed SNM transport system. Correlation of full scale impact test results with structural analysis and scale model testing are also reviewed. 1 ref, 6 figs.

38587 **Projected environmental impacts of radioactive material transportation to the first US repository site.** Neuhauser, K.S.; Cashwell, J.W.; Reardon, P.C.; Ostmeyer, R.M.; McNair, G.W. (Sandia National Labs., Albuquerque, NM, USA; Battelle Pacific Northwest Labs., Richland, WA, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The relative national environmental impacts of transporting spent fuel and other nuclear wastes to each of nine candidate repository sites in the United States of America were analysed. Two scenarios were examined for each repository: (1) shipment of 5 year old spent fuel and defence high level waste (DHLW) directly from their points of origin to a repository (Reference Case); (2) shipment of 5 year old spent fuel to a Monitored Retrievable Storage (MRS) facility and shipment (by dedicated rail) of 10 year old consolidated spent fuel from the MRS to a repository. Transport by either all truck or all rail from the points of origin were analysed as bounding cases. The computational system used to analyse these impacts included the WASTES II logistics code and the RADTRAN III risks analysis code. The radiological risks for the Reference Case increased as the total shipment miles to a repository increased for truck; the risks also increased with mileage for rail but at a lower rate. For the MRS scenario the differences between repository sites were less pronounced for both modal options because of the reduction in total shipment miles possible with the large dedicated rail casks. All the risks reported are small in comparison to 'natural background'. 4 refs, 6 tabs.

38588 **Analytical methodology for estimating the environmental impacts of the transportation of nuclear waste.** Luna, R.E.; Cashwell, J.W.; Neuhauser, K.S. (Sandia National Labs., Albuquerque, NM, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

38589 **Estimated annual worldwide shipments of radioactive material.** Pope, R.B.; McClure, J.D. (International Atomic Energy Agency, Vienna, Austria; Sandia National Labs., Albuquerque, NM, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

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Data on shipments within or from 35 Member States of the IAEA have been used to estimate the volume of radioactive material shipments worldwide. The data have been extrapolated on the basis of gross domestic product and population, and it is estimated that from 18 to 38 million package shipments were made annually in the early 1980s. 5 tabs.

38590 **Summary of radioactive material (RAM) transport in the USA.** McClure, J.D.; Luna, R.E.; Jefferson, R.M.; Reardon, P.C. (Sandia National Labs., Albuquerque, NM, USA; A.K. Tyran-Hopko, E.G. and G. Inc., Idaho Falls, ID, USA; Science Applications, Inc., Rockville, MD, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

38591 **Recent US spent fuel rail shipping campaign.** Voiland, E.E.; Van Hoomissen, J. (General Electric Co., San Jose, CA, USA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vol. 1. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

38592 **Breeder Spent-Fuel Packaging and Transportation Program.** Chitwood, R.B.; Hoof, D.L. (Dept. of Energy, Washington, DC). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The Breeder Spent Fuel Handling and Transportation Program of the United States Department of Energy (DOE) was established in 1983 in order to develop a reliable planning base for interface development at the back end of the liquid metal fast breeder reactor (LMFBR) fuel cycle. It began by addressing the immediate interface needs between the planned Clinch River Breeder Reactor, near Oak Ridge, Tennessee, and the proposed Breeder Reprocessing Engineering Test Facility at Richland, Washington, and concluded by providing a developmental plan leading to a sodium-cooled spent-breeder-fuel transportation cask for a mature 20-reactor LMFBR industry in the year 2025. During the formulation of this plan, as well as during the technology development that constituted the programme, liaison between the DOE and the concerned private-industry operations was maintained by frequent meetings. As a result of functional considerations, it was decided that a legal truck-weight stainless steel multi-assembly package would both be economical and would have unlimited routine possibilities and facility access. As the detailed conceptual design emerged, it included remotely workable, spring-loaded, captive bolts to reduce occupational exposure, internal integral impact limiters and a structurally promising depleted-uranium gamma shield. Modular baskets of a

boron-aluminium alloy, produced by Fonderies Montupet of France, would enhance criticality control and heat transfer, as well as allowing for either a spent fuel or high-level-waste payload. While preliminary calculations have qualified the structure and shielding, heat transfer from a six-assembly payload still poses problems. Details are discussed in the paper. 6 references, 2 figures.

38593 **US DOT specification 6M: radioactive fissile material package nuclear criticality safety re-evaluation.** Hopper, C.M. (Oak Ridge National Lab., TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

A recent nuclear criticality safety analysis of the Department of Transportation Specification 6M fissile-material package is reported for a broad variety of fissile-material loadings including ^{233}U, ^{235}U and ^{239}Pu as metal and the dioxide forms with varying degrees of homogeneous water moderation. The reported results satisfy appropriate criticality safety criteria and specifications of Titles 49 and 10 of the Code of Federal Regulations and the International Atomic Energy Agency Safety Series No. 6 on Regulations for the Safe Transport of Radioactive Material. The results of the nuclear criticality safety analysis form the bases for extending previous Fissile Class I package mass limits for specific package sizes. Each of the fissile isotopes (^{233}U, ^{235}U and ^{239}Pu) were evaluated with four different degrees of water moderation at variable material densities. Also, Fissile Class II ($0.1 <$ transport index < 10.0) package mass limits were determined for the same materials which are applicable to 30, 55 and 110 gallon (US) 6Ms. The re-evaluation demonstrates substantial safe increases of permitted fissile material loadings over generic mass limits previously applied to all sizes of 6M packages (10 to 110 gallon). Previous Fissile Class I (transport index of 0.0) load limits for all 6M package sizes were 1.6 kg ^{235}U, 0.5 kg ^{233}U and 0.9 kg ^{239}Pu for the single moderation limit of hydrogen to fissile material atom ratio of 3 (considering all sources of hydrogen within the 2R vessel). The re-evaluation justifies increasing the load limits for a 30 gallon 6M by factors of 4.3 for ^{235}U, 8.4 for ^{233}U and 6.2 for ^{239}Pu. These particular increases in package utility are the direct result of a specialized and detailed analysis which avoids excesses in safety conservatism.

38594 **Qualified air-transport packaging for metallic plutonium.** Andersen, J.A. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

38595 **Update and insulation testing for uranium hexafluoride transport overpacks. United States Department of Transportation Specification 21PF-1.** Pryor, W.A.; Frazier, J.L. (DOE Oak Ridge Operations Office, TN; Oak Ridge Gaseous Diffusion Plant, TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The slightly enriched product UF_6 shipped from the enriching plants for the world's nuclear power plants must be protected in order to conform to domestic and international transport regulations. The principal overpack currently in use is the US Department of Transportation (DOT) Specification 21PF-1 which protects Model 30 UF_6 cylinders (Title 49, Code of Federal Regulations, Part 178.121, Specification 21PF-1; Fire and Shock Resistant, Phenolic-Foam Insulated, Metal Overpack. Specification 21PF-1 (Horizontal Loading Overpack)). Operational problems have developed from both design and lack of maintenance, resulting in the entry of water into the insulation zone. In order to minimize this water entry, design modifications are necessary to the 21PF-1 overpacks. Proposed modifications for existing overpacks are to be made only after any water absorbed within the phenolic foam insulation is reduced to an acceptable level. New 21PF-1 overpacks will be fabricated under an enhanced design. In both cases, proposed quality assurance/control requirements in the fabrication, modification, use and maintenance of the overpacks are applicable to fabricators, modifiers, owners and users. Design changes are reviewed in Part I. The phenolic foam is the thermal barrier of the protective overpacks, which maintains the UF_6 below its triple point in the event of exposure to elevated temperatures. Evaluation of the thermal qualities of the overpack required extensive analytical modeling correlated with experimental measurement. An experimental programme was devised to measure the thermal conductivity and heat capacity of the phenolic foam from room temperature to approximately 1475°F (1073K). The test programme, which consisted of the guarded hot plate method for thermal conductivity and drop calorimetry for heat capacity determination, is reviewed in Part II. 3 figures.

38596 **Transporting fuel debris from TMI-2 to INEL.** Quinn, G.J.; Burton, H.M.; Bixby, W.W.; McIntosh, T.W.; McGoff, D.J.; Barkanic, R.J.; Henrie, J.O. (EG and G Idaho, Inc., Middletown, PA; UNC Nuclear Industries, Inc., Richland, WA; DOE, Middletown, PA; DOE, Germantown, MD; Bechtel North American Power Corp., Middletown, PA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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Transportation of the damaged fuel from Unit 2 of Three Mile Island (TMI-2) presented noteworthy technical challenges involving complex institutional issues. The transportation programme resulted from both a need to package and remove the accident debris and also the opportunity to receive and study damaged core components. These combined to establish the safe transport of the TMI-2 fuel debris as a high priority for many diverse organizations. The capability of the sending and receiving facilities to handle spent-fuel transport casks in the most cost-effective manner was assessed and resulted in the development by Nuclear Packaging, Inc. (NuPac) of the NuPac 125-B cask. The paper reviews the technical challenges in the preparation of the TMI-2 core debris for transport from TMI-2 to the Idaho National Engineering Laboratory (INEL) and receipt and storage of that material at INEL. Challenges discussed include design and testing of fuel-debris canisters; design, fabrication and licensing of a new rail cask for transport of spent fuel; cask-loading operations, equipment and facilities at TMI-2; transportation logistics; and receipt, storage and core-examination operations at INEL. Poster presentation. 10 references.

38597 **Methodology to evaluate the impact of transportation on systems decisions.** McNair, G.W.; Braitman, J.L.; Holter, G.M. (Battelle Pacific Northwest Labs., Richland, WA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The Pacific Northwest Laboratories, in support of the Department of Energy, have developed two models that provide an analytic basis for making key systems decisions that are influenced by transportation. These models are the TRANSIT model, used to provide a first-order focus on regions of interest to begin specific site-screening activities, and the WASTES model, used to simulate waste-systems interactions and provide detailed logistics and eco-

nomic analyses. The paper discusses these models and their application to the waste-management system.

38598 **Transportation considerations in selecting a nuclear-waste repository.** Wilmot, E.L.; Marks, L.S.; Bolton, P.A. (Dept. of Energy, Washington, DC; Weston/Rogers and Associates, Washington, DC). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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The United States Department of Energy (DOE) has recommended three candidate sites for the first geological repository sites for commercial spent fuel and Defense and commercial high-level waste. Transportation was an important factor in making the selection because it affects many performance objectives of a repository. In developing the detailed influencing factors for transportation and by providing the input used by DOE policy makers to select the sites, it became apparent that distance, the condition of the transportation infrastructure near the site, and site topography were important in influencing site selection. 2 references, 6 figures, 1 table.

38599 **Use of robotics for radioactive-waste shipping and receiving.** Berger, J.D.; Gneiting, B.C.; Sanders, T.L. (Hanford Engineering Development Lab., Richland, WA; Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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Radioactive-waste shipping and receiving facilities presently planned for commercial and Defense high-level nuclear waste will handle waste packages at frequencies far in excess of those in common practice today. If current limits for radiation levels at the cask surface and current handling methods are used, high cumulative personnel exposure to ionizing radiation is projected to occur. To reduce these exposure levels, alternate handling methods are being developed and demonstrated. The production nature of cask-receiving operations suggests commercial robotics be incorporated into a remote-handling system to reduce predicted worker exposure to acceptable levels while maintaining or increasing throughput. The first phase of cask-handling-system development culminated in a proof-of-principle test demonstrating the feasibility of performing cask receiving and unloading operations in a remote and partially automated manner. 7 references, 5 figures.

38600 **Thermal benchmarking: a status report.** Glass, R.E. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

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A series of benchmarks are being developed for evaluating codes used in the design and licensing of transportation systems for nuclear materials. The development of the benchmarks includes (1) definition of a problem set, (2) numerical solutions, and (3) experimental verification. The first two steps have been completed and the plans for experimental verification are being developed. In conjunction with this domestic programme, a proposal was made to the Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD/NEA) for an international effort. A problem set was subsequently defined and agreed upon for the first phase of the international intercomparison of codes. The paper discusses the status and future activities of the benchmarking effort in the United States of America and reviews the status of international efforts. Poster presentation. 1 figure.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 38566, 38567, 38681

0520 Waste Management

REFER ALSO TO CITATION(S) 38579, 38580, 38587, 38598, 38666, 38848, 39212, 39213, 39225, 39730

38601 **(BMI/ONWI—648) SIMREP 1.1: A simulation model for repository operations.** Tarapore, P.S.; Gupta, R.; Clark, G.M. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 116p. NTIS, PC E06/MF A01; GPO Dep. File Number DE87012852.

Includes 1 sheet of 24x reduction microfiche.

This report serves as a documentation for SIMREP 1.1, a discrete event computer simulation model of repository operations in the surface waste-handling facility. The logic for this model is provided by Fluor Technology, Inc., the Architect/Engineer of the salt repository. Part I of this report deals with simulation techniques and program design. Simulation methods and the use of the SIMSCRIPT II.5 simulation language are discussed. Repository operations modeled in SIMREP are briefly described. Detailed program logic is included in an appendix. Part II of this report is a guide for the use of SIMREP 1.1. Input data requirements, output file organization, and software and hardware specifications are described in detail. A sample problem is provided to illustrate the use of SIMREP 1.1. The required input data and the resulting output files for the sample problem are shown in appendices.

38602 **(BMU—1986-125) Final storage of radioactive waste - survey of technical concepts in the international field.** Mielke, H.G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 45p. (In German). (GRS-A—1191). NTIS, PC E07; Available from NTIS as TIB/B87-06370.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This report gives a survey of international concepts on the final storage and disposal of radioactive waste. The main point is the technical design of existing final stores for radioactive waste, and those under construction and being planned in France, Great Britain, Sweden, Switzerland and the USA.

38603 **(BNL—52074) Solidification of low-level radioactive wastes in masonry cement.** Zhou, H.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012305.

Portland cements are widely used as solidification agents for low-level radioactive wastes. However, it is known that boric acid wastes, as generated at pressurized water reactors (PWR's) are difficult to solidify using ordinary portland cements. Waste containing as little as 5 wt % boric acid inhibits the curing of the cement. For this purpose, the suitability of masonry cement was investigated. Masonry cement, in the US consists of 50 wt % slaked lime ($CaOH_2$) and 50 wt % of portland type I cement. Addition of boric acid in molar concentrations equal to or less than the molar concentration of the alkali in the cement eliminates any inhibiting effects. Accordingly, 15 wt % boric acid can be satisfactorily incorporated into masonry cement. The suitability of masonry cement for the solidification of sodium sulfate wastes produced at boiling water reactors (BWR's) was also investigated. It was observed that although sodium sulfate - masonry cement waste forms containing as much as 40 wt % Na_2SO_4 can be prepared, waste forms with more than 7 wt % sodium sulfate undergo catastrophic failure when exposed to an aqueous environment. It was determined by x-ray diffraction that in the presence of water, the sulfate reacts with hydrated calcium aluminate to form calcium aluminum sulfate hy-

drate (ettringite). This reaction involves a volume increase resulting in failure of the waste form. Formulation data were identified to maximize volumetric efficiency for the solidification of boric acid and sodium sulfate wastes. Measurement of some of the waste form properties relevant to evaluating the potential for the release of radionuclides to the environment included leachability, compression strengths and chemical interactions between the waste components and masonry cement. 15 refs., 19 figs., 9 tabs.

38604 **(CONF-860990—Pt.1) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 1, Disposal technology.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012442.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

All papers in this volume have been processed for inclusion in the Energy Data Base. (AT)

38605 **(CONF-860990—Pt.2) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 2, Site closure.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012443.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This volume on site closure or site stabilization and closure, centers on a number of major issues which have been identified by the contractor community as requiring resolution before the topic of site stabilization and closure can be laid to rest. All papers, seven total, in this volume have been processed for inclusion in the Energy Data Base. (AT)

38606 **(CONF-860990—Pt.3) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 3, Low-level waste information: Data and systems.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012444.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Selected papers in this proceedings have been processed for inclusion in the Energy Data Base. (AT)

38607 **(CONF-860990—Pt.4) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 4, State/regional progress.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012445.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Selected papers have been processed for inclusion in the Energy Data Base. (AT)

38608 **(CONF-860990—Pt.5) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 5, Performance assessment.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012446.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Selected papers have been processed for inclusion in the Energy Data Base. (AT)

38609 **(CONF-860990—Pt.6) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 6, Waste treatment.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012447.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Nine papers in this proceedings have been processed for inclusion in the Energy Data Base. (AT)

38610 **(CONF-860990—Pt.7) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 7, Waste characterization and regulation.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012448.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Selected papers have been processed for inclusion in the Energy Data Base. (AT)

38611 **(CONF-860990—Pt.8) Proceedings of the eighth annual DOE low-level waste management forum: Technical Session 8, Future DOE low-level waste management.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012449.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This volume contains the following papers: (1) DOE Systems Approach and Integration; (2) Impacts of Hazardous Waste Regulation on Low-Level Waste Management; (3) Site Operator Needs and Resolution Status; and (4) Establishment of New Disposal Capacity for the Savannah River Plant. All papers have been processed for inclusion in the Energy Data Base. (AT)

38612 **(CONF-860990—Summ.) Proceedings of the eighth annual DOE low-level waste management forum: Executive summary, opening plenary session, closing plenary session, attendees.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012441.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Eighth Annual DOE (Department of Energy) Low-Level Waste Management Forum was held in September 1986, in Denver, Colorado, to provide a forum for exchange of information on low-level radioactive waste (LLW) management activities, requirements, and plans. The one hundred ninety attendees included representatives from the DOE Nuclear Energy and Defense Low-Level Waste Management Programs, DOE Operations Offices and their contractors; representatives from the US Nuclear Regulatory Commission (NRC), US Environmental Protection Agency (EPA), US Geological Survey, and their contractors; representatives of states and regions responsible for development of new commercial low-level waste disposal facilities; representatives of utilities, private contractors, disposal facility operators, and other parties concerned with low-level waste management issues. Plenary sessions were held at the beginning and conclusion of the meeting, while eight concurrent topical sessions were held during the intervening two days. The meeting was organized by topical areas to allow for information exchange and discussion on current and future low-level radioactive waste management challenges. Session chairmen presented summaries of the discussions and conclusions resulting from their respective sessions. Selected papers in this volume have been processed for inclusion in the Energy Data Base.

38613 **(CONF-870822—2) Development and operation of the conversion/solidification process for the CEUSP [Consolidated Edison Uranium Solidification Program] project.** Hall, R.; Collins, E.D.; Johnson, J.K.; Krichinsky, A.M.; McGinnis, C.P.; Patton, B.D.; Shor, J.T.; Vedder, R.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012249.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

A project called the Consolidated Edison Uranium Solidification Program (CEUSP) was initiated to solidify radioactive uranium from Indian Point-1 Reactor for storage. Process steps included evaporation, denitration by formaldehyde, thermal denitration, and encapsulation. Following solidification of the Indian Point-1 uranium, and another batch of uranium, the CEUSP Facility and the Thorium Reactor Uranium Storage Tank were cleaned out. (DLC)

38614 **(DOE/AL/10752—36) Post burial alteration of the Permian Rustler Formation Evaporites, WIPP [Waste Isolation Pilot Plant] site, New Mexico: Textural, stratigraphic and chemical evidence.** Lowenstein, T.K. (New Mexico Health and Environment Dept., Santa Fe (USA). Environmental Evaluation Group). Apr 1987. Contract AC04-78AL10752. 68p. (EEG—36). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010504.

The Rustler Formation is a Late Permian (Ochoan Series) evaporite found in the subsurface and in outcrop in New Mexico and west Texas. The main rock types of the Rustler Formation are anhydrite, gypsum, halite, dolostone and siliciclastic sandstone and mudstone. Across the WIPP site, located in southeastern New Mexico, some of the Rustler rock types and their thicknesses change dramatically over short lateral distances. These lateral variations have mainly been attributed to post-burial dissolution of evaporites. The aim of the present study is to distinguish syndepositional features from post burial alteration features in the Rustler Formation. Four borehole cores of the complete Rustler Formation were examined. Primary sedimentary structures, textures and fabrics were identified, based on comparison with modern evaporite deposits. Vertical and lateral patterns of primary sedimentary features were recorded. From this information, depositional settings have been assembled which best account for the observed types of primary features and their vertical and lateral distribution. With this framework, post-depositional diagenetic overprints were identified in the Rustler Formation. The question of whether subsurface diagenetic alteration is presently active at the WIPP site is addressed.

38615 **(DOE/CH—15-0) Draft Area Recommendation Report for the Crystalline Repository Project: Overview.** (USDOE Chicago Operations Office, Argonne, IL. Crystalline Repository Project Office). Jan 1986. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012335.

The draft Area Recommendation Report (ARR) for the Crystalline Repository Project identifies portions of crystalline rock bodies as proposed potentially acceptable sites for the Nation's second repository for deep geologic burial of high-level radioactive waste and spent nuclear fuel. This Overview provides a brief summary of that report. The US Department of Energy (DOE) evaluated available geologic and environmental data for 235 crystalline rock bodies in the North Central, Northeastern, and Southeastern Regions to identify preliminary candidate areas. The 12 proposed potentially acceptable sites are located in the States of Georgia (1), Maine (2), Minnesota (3), New Hampshire (1), North Carolina (2), Virginia (2), and Wisconsin (1). The data, analyses and rationale pertaining to the identification of the 12 proposed potentially acceptable sites are presented in the draft ARR. The analyses presented in the draft ARR demonstrate that the evidence available for each proposed potentially acceptable site supports (1) a finding that the site is not disqualified under Appendix III of the DOE Siting Guidelines and (2) a decision to proceed with the continued investigation of the site on the basis of the favorable and potentially adverse conditions identified to date. These potentially acceptable sites will be investigated and evaluated in more detail during the area phase of the siting process and considered along with other candidate sites in a progressive narrowing process to finally choose the site of the second repository in 1998.

38616 **(DOE/CH/10274—1) Final report in review of the Department of Energy's CRP [Crystalline Repository Project]: ARR and related documentation.** (Grand Portage Reservation Business Committee, MN (USA)). [1987]. Contract FG02-86CH10274. 77p. NTIS, PC A05. File Number DE87008614.

Legal aspects of using Indian Reservations for a storage site of spent fuels or high-level radioactive wastes are discussed in light of nuclear waste policy and existing Indian treaties. (PSB)

38617 **(DOE/ID/12650—1) Prototypical spent fuel consolidation equipment: Phase 1, Preliminary design report.** Matheson, J.E.; Townes, G.A.; Woodhall, C.B. (Babcock and Wilcox Co., Lynchburg, VA (USA); BE, Inc., Barnwell, SC (USA); Nuclear Assurance Corp., Norcross, GA (USA); Babcock and Wilcox Co., Alliance, OH (USA). Contract Research Div.). Dec 1986. Contract AC07-86ID12650. 349p. (BAW—1984). NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87012423.

Phase I of the Prototypical Fuel Rod Consolidation Program challenged participants to achieve a preliminary design of the system at a 75% confidence level within a 17-week time frame. The Babcock & Wilcox (B & W) Team's response to this challenge is the Fuel Master(TM) consolidation equipment. This report describes the unique design and provides extensive analyses of the operational and safety aspects of the system. This summary discusses the main features of the system and summarizes the key results of analyses.

38618 **(DP-MS—87-42) Utilization of LOTUS computer program for rotary kiln, secondary combustion chamber and off-gas system design for a mixed and LLW incinerator.** Sanders, N.; Voshell, M.E. (Main (Charles T.), Inc., Charlotte, NC (USA)). Apr 1987. Contract AC09-76SR00001. 12p. (CONF-870429—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011176.

From 6. annual conference on incineration of mixed and low-level radioactive wastes; St. Charles, IL, USA (22 Apr 1987).

This paper discusses the advantages of the LOTUS 1-2-3 spreadsheet as used in the design of an incineration facility. The program is used to calculate material and energy balances, excess air requirements, and temperature control requirements. The flexibility of the LOTUS system in exploring a variety of design scenarios is discussed. The spreadsheet models a rotary kiln which burns solids and liquids and a secondary combustion chamber which burns liquids. The incineration facility uses a wet scrubbing off-gas system for particulates and acid gas removal and control. The computer program is extremely useful for calculating excess air and fuel oil requirements for incineration system temperature control and for determining off-gas system flow rates. The single most important factor is that once all the chemical equations for all wastes to be fired have been developed and the spreadsheet set up, any number of cases may be evaluated. This is essential to compare the effects of feed components on flue gas volume, quantities of acid gases and metal oxides generated, and particulate loading, all of which affect the proper sizing, selection and cost of equipment.

38619 **(DPSP—87-1008) Venture Guidance Appraisal cost estimates for groundwater protection Environmental Impact Statement.** Moyer, R.A. (Savannah River Lab., Aiken, SC (USA)). 31 Mar 1987. Contract AC09-76SR00001. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012410.

Cost estimates were prepared for closure options at criteria waste sites and alternatives for new disposal facilities for hazardous wastes, mixed wastes, low level radioactive wastes and slurry from liquid waste treatment facilities. Because these cost estimates will be used in the Groundwater Protection EIS, the goal was to develop "enveloping" costs, i.e., the alternative or option chosen for execution at a later date should cost no more than the estimate. This report summarizes scenarios for making detailed cost estimates. Also included are unit costs for disposition of potential excavations, for operational activities, and for groundwater monitoring and site maintenance after closure of the site. The cost numbers presented

are intended for study purposes only and not for budgetary activities.

38620 **(EGG-WM—7636) Hazardous Waste Programs 1986 annual report.** Nishimoto, D.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1987. Contract AC07-76ID01570. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012427.

This report describes the annual status of the Hazardous Waste Programs at EG & G Idaho, Inc., for CY 1986. Topics covered include: (1) a summary of the year's significant events and/or accomplishments, (2) the current compliance status of the hazardous waste management facilities operated by Hazardous Waste Programs, (3) updated information on all INEL-generated hazardous, PCB-contaminated, and radioactive mixed wastes that were handled during CY 1986, and (4) summaries of the Programs' major activities.

38621 **(EGG-WM—7637) Idaho National Engineering Laboratory hazardous and radioactive mixed waste identification and characterization report for CY 1986.** Nishimoto, D.D. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1987. Contract AC07-76ID01570. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012429.

This report provides updated tabulations of the hazardous and radioactive mixed wastes generated and/or handled during CY 1986 at each INEL facility operated by EG and G, or any other operating contractor at the Site. These wastes are described in tabular form, providing information such as composition, generating process, contact person, EPA hazardous waste designation, quantity shipped off site (if applicable), and quantity in storage. Waste generation projections for the next ten years are also included for all INEL facilities. Finally, since many of EG and G's inactive disposal sites may prove to be significant sources of either hazardous or radioactive mixed wastes as remedial action activities under RCRA or CERCLA progress, information on these sites is provided. 2 refs., 1 fig., 8 tabs.

38622 **(EGG-WT—7610) Implementation plans for buried transuranic waste and stored special-case waste at the Idaho National Engineering Laboratory.** Bullock, M.G.; Rodriguez, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1987. Contract AC07-76ID01570. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012428.

This document presents the current implementation plans for buried transuranic waste and stored special-case waste at the Idaho National Engineering Laboratory. Information contained in this report was also included in several Department of Energy (DOE) planning documents for the Defense Transuranic Waste Program. This information can be found in the following DOE documents: Comprehensive Implementation Plan for the DOE Defense Buried TRU Waste Program; Defense Waste Management Plan for Buried Transuranic-Contaminated Waste, Transuranic-Contaminated Waste, Transuranic-Contaminated Soil, and Difficult-to-Certify Transuranic Waste; and Defense Special-Case Transuranic Waste Implementation Plan. 11 refs.

38623 **(GSF—32/86) Radiation protection and environmental monitoring in the area of the Asse shaft plant. Annual report 1985.** Mueller-Lyda, I.; Meyer, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). Sep 1986. 44p. (In German). (GSF-T—256). NTIS, PC E07; Available from NTIS as TIB/B87-08676.

Personnel monitoring has been carried through in compliance with the Radiation Protection Ordinance. Environmental monitoring including measurement of local doses, local dose rates, and airborne radioactivity in the shaft has been made according to the provisions for radiation protection at the place of work. Maximum permissible personal doses or activity levels for occupationally exposed persons have not been exceeded in the reporting period. Exhaust air monitoring detected the nuclides H-3, C-14, Pb-210, and the short-lived daughter products of Rn-222 and Rn-220. The activity concentrations in the environment, determined from the measured annual release values, for some part have been lower than the average of natural concentrations of said nuclides. The radiation exposure due to emissions, measured at the least favourable point in the environment, has been far below the limits set by the Radiation Protection Ordinance. In conclusion: The radiation exposure of the personnel and of the population in the area of the Asse shaft plant due to the storage of radioactive waste and the research activities in the salt mine has been a very low, compared to the natural radiation exposure.

38624 **(GSF—40/86) Nuclear waste repository simulation experiments. Asse salt mine. Annual report 1985.** Rothfuchs, T.; Wieczorek, K.; Feddersen, H.K.; Staupendahl, G.; Coyle, A.J.; Kalia, H.; Eckert, J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Remlingen (Germany, F.R.). Inst. fuer Tieflagerung; Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1986. 234p. (GSF-T—260). NTIS, PC E15; Available from NTIS as TIB/B87-08598.

This document is the third joint annual report on the Cooperative German-American 'Brine Migration Tests' that are in progress at the Asse salt mine in the Federal Republic of Germany (FRG). This Government supported mine serves as an underground test facility for research and development (R and D)-work in the field of nuclear waste repository research and simulation experiments. The tests are designed to simulate a nuclear waste repository to measure the effects of heat and gamma radiation on brine migration, salt decrepitation, disassociation of brine, and gases collected. The thermal mechanical behavior of salt, such as room closure, stresses and changes of the properties of salt are measured and compared with predicted behavior. This document covers the following sections: Issues and test objectives: This section presents issues that are investigated by the Brine Migration Test, and the test objectives derived from these issues; test site: This section describes the test site location and geology in the Asse mine; test description: A description of the test configuration, procedures, equipment, and instrumentation is given in this section; actual test chronology: The actual history of the test, in terms of the dates at which major activities occured, is presented in this section. Test results: This section presents the test results observed to data and the planned future work that is needed to complete the test; conclusions and recommendations: This section summarizes the conclusions derived to date regarding the Brine Migration Test. Additional work that would be useful to resolve the issues is discussed.

38625 **(GSF-R—418) GSF Institute for Radio-Hydrometry. Annual report 1985.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie). May 1986. 221p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-06258.

The report devotes 3 chapters to describing the work of the Institute. In the sector of 'basic investigations', there were measurements of the isotope contents of precipitation and groundwater (/sup 2/H, /sup 18/O, /sup 36/Cl) and groundwater isotope dating using /sup 3/He and /sup 4/He. In the field of 'applied investigations', work was done on local flow fields with single borehole measurements and hydrological conditions on the Asse (mountains) in connection with the storage of radio-active waste and the spread of radio-nuclides in ventilated rocks in the area of the planned final store at Gorleben and isotope hydrological investigations in the Upper Harz mountains and in the Antarctic were carried out. The 3rd chapter summarizes the apparatus and method developments in connecting with these investigations. The report closes by listing the publications, lectures and other institutions co-operating in the work.

38626 (IAEA-SR—110, pp 34) **Design and operational experience of the centre for the collection, treatment and storage of low level radioactive wastes.** Zorrilla, S. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38627 (IAEA-SR—110, pp 38) **Management for low and intermediate level wastes in Brazil.** Franzen, H.R. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38628 **(IAEA-SR—110) Proceedings of the Seminar on Management Options for Low and Intermediate-Level Wastes in Latin America - Abstracts.** (International Atomic Energy Agency, Vienna (Austria)). 1986. 86p. (CONF-861065—Absts.). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447.

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The solutions adapted for management problems on radioactive wastes of nuclear installations and contaminated materials generated in hospitals, research centers, laboratories in the countries of Latin America are presented. The criteria of site selection for radioactive waste installation and the methods for treating and storage are evaluated. The results of inspections in installations which handle radioactive wastes are done. (M.C.K.).

38629 (IAEA-SR—110, pp 19) **Management of hospital radioactive wastes.** Mantrana, D. (Centro de Investigaciones Nucleares, Montevideo, Uruguay). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38630 (IAEA-SR—110, pp 2) **Radioactive waste management at the Peruvian Nuclear Energy Institute.** Mallaupoma G, M.C. (Instituto Peruano de Energia Nuclear, Lima). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38631 (IAEA-SR—110, pp 9) **Argentina's radioactive waste disposal policy.** Palacios, E. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38632 (IAEA-SR—110, pp 15) **Low-level waste management at the Nuclear Research Centre.** Calisto, W.; Montanez, O.; Blanco, D.; Vallarino, V. (Centro de Investigaciones Nucleares, Montevideo, Uruguay). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38633 (IAEA-SR—110, pp 26) **Management of low-level radioactive wastes in Mexico.** Olivares O, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38634 (IAEA-SR—110, pp 37) **Angra 1-Conditioning of radioactive wastes and related problems.** Meldonian, N.L. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

38635 **(IAEA-SR—110(Add.)) IEN low-level radioactive waste management.** Rocha, A.C.S. da; Pina, J.L.S.; Silva, S. da; Silva, J.J.G. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Sep 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702448.

The low-level radioactive waste produced in Instituto de Engenharia Nuclear is generated basically from three distinct modes: a particle accelerator (CV-28 Cyclotron), radiochemistry laboratories, and the operation of a nuclear research reactor (Argonaut type). In the Cyclotron unit, all water flow from hot labs as well as from the decontamination laundry is retained in special tank with homogenizing system and a remote control that signalizes when the tank gets a pre-specified level. Samples homogenized from the tank are collected for analysis.

38636 (INIS-mf—10632, pp 126) **Borehole convergence and stress relaxation in salt deposits.** Borm, G. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38637 (INIS-mf—10632, pp 127) **Micro-seismic and seismo-acoustic observations by a heating experiment in rock salt.** Hente, B.; Flach, D.; Gommlich, G.; Wieczorek, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38638 (INIS-mf—10632, pp 128) **Results of geo-electric measurements and calculations of the transport of alkaline solutions during a heating experiment in the salt mine Asse.** Kessels, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38639 (INIS-mf—10632, pp 129) **Results of a heating experiment with a high heat transfer factor in the salt mine Asse.** Kessels, W.; Feddersen, H.K.; Gies, H.; Hente, B.; Jockwer, N.; Rothfuchs, T.; Wieczorek, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38640 (JAERI-M—86-131) Progress report on safety research of high-level waste management for the period April 1985 to March 1986. Nakamura, Haruto; Tashiro, Shingo (eds.). (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 108p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702528.

Research on high level waste management in fiscal year of 1985 is reviewed. Topics are as follows; 1) Glass waste form was examined with emphasis on the leaching mechanisms under various conditions to predict the long-term leach rates. Leaching rate was examined in synthesized groundwater and a leaching model was developed. Cooperation between Japan and Australia on development of SYNROC has started. 2) Heating experiments with a real size simulated canister and migration tests using non-sorbing tracer has been carried out in a near surface granite rock mass. 2D-SEEP, the coupled computer code of heat and groundwater flow, has been developed. 3) Japanese group participated the ESOPE project of OECD/NEA SWG. Small particles of an organic phase was found in sediment as a material to have significant influence on technetium fixation. 4) Alpha radiation stability of vitrified forms under beta and gamma irradiation have newly started in WASTEF.

38641 (Juel—2099) Strategy of radioactive waste management of special materials. Bruecher, H.; Merz, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Nov 1986. 145p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-08649.

Special attention is being paid to the treatment and disposal of the volatile radionuclides tritium, carbon-14, krypton-85, and iodine-129 arising from reprocessing of spent nuclear fuel. This is shown by a large number of investigations on this subject as well as the 1983 recommendation of the German Radiation Protection Commission. In the present study, recent investigations on these four nuclides have been analysed, and it has been tried to draw conclusions for the realisation of the management concept for these radionuclides.

38642 (KFK—4202) Laboratory experiments on cementation of tritiated water. Rudolph, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Feb 1987. 24p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-08596.

Cementation of tritiated water arising from fuel reprocessing has been studied as an alternative disposal method if deep well disposal will not be possible. A solid product containing at least 85 wt.% of water can be made using slag cement with an addition of a swelling bentonite. The preferred procedure is to produce a suspension of bentonite and water followed by mixing with cement. The tendency of these products to bleeding, their compressive strength and other relevant data were determined. The use of a dry mix of cement and bentonite, seemingly the simpler process, has also been investigated. This variant, however, allows lesser amounts of water to be incorporated; it will, therefore, no longer be considered.

38643 (LA—11070-MS) Lateral continuity of sorptive mineral zones underlying Yucca Mountain, Nevada. Campbell, K. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012415.

Mineralogical investigations at Yucca Mountain in southwestern Nevada are part of the characterization of this site for a potential nuclear waste repository. This report analyzes compositional data obtained by x-ray powder diffraction for several hundred samples from fourteen drill holes in the vicinity of Yucca Mountain. Mineralization is compared with the functional stratigraphy for the region. Three major zeolitized intervals below the Topopah Spring Member of the Paintbrush Tuff are of particular interest because of their potential to retard the transport of dissolved radionuclides. No significant lateral trends in total zeolitization within these units are noted in the neighborhood of the Exploration Block, but there are trends in the abundances of the individual zeolites. Much local variation that cannot be explained by either vertical or lateral trends is observed.

38644 (LA—11081-PR) Laboratory and field studies related to the Radionuclide Migration Project: Progress report, October 1, 1985-September 30, 1986. Thompson, J.L. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012352.

In this report we describe the work done at Los Alamos in support of the Radionuclide Migration project during fiscal year 1986. We have continued to monitor the transport of tritium and ^{85}Kr from the Cambric explosion zone to the satellite well, which is pumped at 600 gal/min. Corresponding movement of cationic radionuclides such as ^{137}Cs and ^{90}Sr has not yet been observed after 12 yr of pumping, nor have we seen evidence that these strongly sorbing ions move in conjunction with colloids. We have analyzed more data from the Cheshire study site but have not resolved the uncertainties regarding the distribution and movement of radioactive materials at this location. Our attempts to improve our analytical capability for ^{36}Cl and ^{99}Tc have resulted in some progress. Similarly, we have increased our understanding of radionuclide transport phenomena such as channeling in fracture flow and anion exclusion in zeolites and clays. A sample exchange with Lawrence Livermore National Laboratory has helped us identify critical steps in our procedures for collecting and analyzing large-volume water samples. We have surveyed potential sites on Pahute Mesa at the Nevada Test Site for future radionuclide migration studies and conclude that there are none other than Cheshire presently available, and none are likely to be created in the near future. The Laboratory has engaged recently in radionuclide migration studies sponsored by our weapons program; we reviewed this work in an appendix to the annual report.

38645 (NAGRA-NTB—85-17) Gas formation in a L/ILW repository and gas transport in the host rock. Wiborgh, M.; Hoeglund, L.O.; Pers, K. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1986. 144p. Nagra, CH-5401 Baden, Switzerland.

In a repository for low- and intermediate-level radioactive waste, gases will be formed due to corrosion, microbial degradation and radiolytic decomposition. The predominant gas formation process is anaerobic corrosion of metals which yields over 90% of all gases formed, based on a corrosion rate of 10^{-4} - 10^{-3} mm/year. In this report, gas transport in the system of engineered barriers and gas transport in the host rock are treated separately. The pressure build-up required to form crac/ks in the repository liner has been estimated and compared with the pressure required for gas transport in an unfractured barrier. The assumed range of permeabilities for the concrete barrier is $1x10^{-20}$ - $1x10^{-17}$ m^2. The gas transport in the host rock is calculated for permeabilities of $1x10^{-19}$ - $1x10^{-15}$ m^2. The transport routes for the gases are the undisturbed host rock and the lineaments. The gas transport capacity in the host rock is sufficiently high to balance the rate of gas formation and has been found to be independent of the capacity in the lineaments when the permeability in the host rock is higher than 10^{-17} m^2. The gas transport capacities are calculated for a rock material with distributed fissure sizes. The relative permeability for the gas has been calculated using capillary pressure curves for three different rock materials - dolomite, sandstone and limestone. Additional calculations have been made for uniformly sized fissures.

38646 (NAGRA-NTB—86-27) Resaturation of backfilled tunnels in granite. Andrews, R.W.; La Fleur, D.W.; Pahwa, S.B. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1986. 77p. Nagra, CH-5401 Baden, Switzerland.

Highly compacted bentonite clay is proposed for use as a backfill material around high level waste overpacks to be placed in excavated tunnels in the crystalline bedrock of Northern Switzerland. Initially the bentonite will have a low residual water content and with time the bentonite will resaturate due to the influx of water from the crystalline rock. The time and degree of bentonite saturation are important for safety assessment because of their effect on the corrosion of the waste overpack, on the leaching of the waste matrix, and on the radionuclide transport in the backfill. A three-dimensional, two-phase flow model (FAMOS) is used to

quantify the expected resaturation under the conditions outlined above. The time required for complete saturation simulated using FAMOS ranges from less than 100 to more than 1000 years. These results are comparable to the results of diffusive models of bentonite saturation when using a diffusion coefficient of $3x10^{-10}$ m^2s^{-1}. The time depends on the hydraulic properties of the bentonite as well as the saturated hydraulic conductivity of the crystalline rock. At saturated granite hydraulic conductivities of the order of 10^{-9} ms^{-1} the bentonite becomes fully saturated in less than 100 years. For saturated granite hydraulic conductivities of the order of 10^{-12} ms^{-1} the bentonite becomes fully saturated in several hundred to over 1000 years. For a given granite hydraulic conductivity the degree of saturation depends on the bentonite capillary pressure versus water saturation characteristic relationships. For high capillary pressures (of the order of 10^5 kPa) the bentonite saturates relatively quickly; with lower capillary pressures the time for complete saturation increases.

38647 **(PNL-SA—14508) Comparison of rheological evaluation techniques and turbulent flow prediction of a simulated nuclear waste melter slurry.** Carleson, T.E.; Hart, R.E.; Drown, D.C.; Peterson, M.E. (Idaho Univ., Moscow (USA). Dept. of Chemical Engineering; Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 43p. (CONF-870324—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012164.

From 12. international conference on slurry technology; New Orleans, LA, USA (30 Mar 1987).

An experimental study was performed on a simulated nuclear waste slurry containing the type of waste sludge and glass-forming chemicals that will be converted to a stable glass in a high-temperature furnace. The rheological properties of the slurry must be determined in order to design the transport and mixing systems. The rheological parameters for the slurry were determined by a variety of viscometers including a rotational viscometer, a capillary tube viscometer, and a pipe flow apparatus. Experiments revealed the absence of wall slip and sufficient non-Newtonian behavior to require adjustments of the results. The slurry was characterized as a yield pseudoplastic fluid. Different rheological constants were obtained for all three viscometers. Predictions of the shear stress as a function of shear rate showed good agreement between the constants determined by the rotational viscometer and the pipe loop apparatus. Laminar and turbulent flows in the pipe loop correlated closely with a recent theoretical model. 16 refs., 16 figs., 5 tabs.

38648 **(PNL-SA—14821) Progress of air oxidation tests on spent light-water reactor fuel in an imposed gamma field.** Gilbert, E.R.; Campbell, T.K.; Thornhill, C.K.; Piepel, G.F. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 16p. (CONF-870437—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011143.

From Workshop on chemical reactivity of oxide fuel and fission product release; Gloucestershire, UK (6 Apr 1987).

The Spent Fuel Oxidation Program at Pacific Northwest Laboratory (PNL) is directed towards providing a data base for the oxidation behavior of spent light-water reactor (LWR) fuel. This information will establish the basis for (1) determining the temperature above which monitoring for loss of an inert storage atmosphere is required, (2) assessing fuel conditions in the case of an abnormal event (e.g., air inleakage into a cask with an inert cover gas), and (3) determining acceptable exposure and temperature conditions for fuel storage in air. An oxidation test matrix was designed to provide an adequate number of specimens and testing conditions to determine the statistical significance of the following variables: temperature, exposure period, and moisture of the test atmosphere. Various spent fuels are being tested, including pressurized-water reactor (PWR) and boiling-water reactor (BWR) fuels from different reactors. To simulate dry storage conditions, a gamma field of about 10^5 R/h was imposed. Test results to date reveal that higher levels of irradiation, as indexed by burnup level, increase the stability of the basic UO_2 crystal structure. Consequently, oxidation of specimens with higher burnup levels resulted in larger weight gains and longer periods before low-density powder formed. For all burnup levels tested, the spent UO_2 fuel crystal structure was more resistant to low-density powder formation than the nonirradiated UO_2 pellet crystal structure.

38649 **(PNL-SA—14836) Lessons learned from the HYDROCOIN experience.** Cole, C.R.; Nicholson, T.J.; Davis, P.; McCartin, T.J. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC06-76RL01830. 18p. (CONF-870450—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012166.

From Symposium on verification and validation of geosphere performance assessment models; Stockholm, Sweden (7 Apr 1987).

This report was prepared for the HYDROCOIN Coordinating Group that directs the HYDROlogic COde INtercomparison study. It summarizes the "lessons" learned from the study to date, principally the model verification and validation phases. HYDROCOIN is an international study organized by the Swedish Nuclear Power Inspectorate to investigate the impact of various groundwater modeling strategies on performance assessments of radioactive waste disposal sites. Twenty different organizations using 25 different hydrologic computer codes from 11 different countries participated in the verification phase of the project. Specially designed hydrological problems were developed or taken from the technical literature to address the issues of model verification, validation, and uncertainty and sensitivity analyses for a wide variety of hydrologic flow conditions. Current efforts deal with completing the validation phase of the study, which has been confined to relatively simple comparisons of model results to limited field and laboratory data sets. The final sensitivity and uncertainty phase, which has recently begun, will be used to explore appropriate ways of using hydrogeologic models in performance assessments to account for the uncertainties in conceptual models and hydrogeologic parameters. Lessons learned from HYDROCOIN experiences include developing a better understanding of the limitations of the codes, available data sets, and various modeling strategies. The diversity in lessons range from general lessons (e.g., lessons regarding verification problem selection, formulation, and methods for comparison) through very specific lessons (e.g., the appropriate way to specify Dirichlet boundary conditions at the juncture with a no-flow boundary). 12 refs.

38650 **(PTB-SE—11) Analytical estimate for filling the Konrad shaft system with water and of the build-up of pressure, taking convergence into account and using a simple one-dimensional model.** Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Aug 1986. 30p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06268.

For the long term safety of the shaft system with negligible thermal effect of the basic rock, one must consider the possible spread of radionuclides with movement of the groundwater. The pit building is situated in coral oolite, which is a conductor of fissure water of low conductivity. After the end of the working phase, the incoming water will slowly fill the pit building. The pressure reducing funnel, which was formed during the working and incoming water phase, will be gradually levelled out after filling up, until after a long period the original pressure conditions will be restored. The hollow spaces in the pit building accessible to water will be reduced in the course of time by convergence processes; by this reduction in volume, water can be pushed out of the completely filled pit building. This increases the pressure in the surrounding water conductor. Using a simple one-dimensional model one tries by varying the parameters, to obtain quantitative information. Convergence rate and permeability coefficients of the water conductor are varied. The incoming water and pushing out phase can be treated mathematically like trench flow. Calculations of the time and space dependence of the pressure are done for two rates of convergence and three different permeability coefficients. It was found that the additional increase of pressure due to convergence is always far below the total pressure. The levelling out of the pressure reduction funnel occurs slowly, so that the hydrostatic pressure is not exceeded. It follows that pushing out processes, by which water with radioactive nuclides could get from pit buildings via preferred paths into the biosphere are of lesser importance.

38651 **(SAND—85-1964) Cost estimate of the Yucca Mountain repository based on the site characterization plan conceptual design: Nevada Nuclear Waste Storage Investigations Project.** Gruer, E.R.; Fowler, M.E.; Rocha, G.A. (Sandia National Labs., Albuquerque, NM (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA); Bechtel National, Inc., San Francisco, CA (USA)). Jun 1987. Contract AC04-76DP00789. 132p. NTIS, PC A07. File Number DE87012508.

This report of the life-cycle costs of a mined repository in tuff is based on the site characterization conceptual design and contains estimates of two methods of waste emplacement - vertical and horizontal. The life cycle of the repository progresses from design and construction to emplacement operations that last 25 years. When emplacement has ended, a caretaker period begins and continues until 50 years from emplacement of the first waste. The life of the repository concludes with closure and decommissioning, which includes backfilling and sealing the repository, decontaminating and razing the surface facilities, restoring the land to as near its original condition as possible, and marking the site. The estimates, developed for each phase of the life cycle of the repository, are based on January 1986 constant (unescalated) dollars and include an allowance for contingency. This report mainly comprises explanations of design and operating assumptions, estimating methods, exclusions, definition of cost accounts, calculating procedures, data sources, staffing and other qualifying remarks. Cost estimates are approximations of value and should not be construed as exact. The cost and staffing detail provided in this estimate is commensurate with the detail in the conceptual design.

38652 **(SAND—85-7112) An engineering study of the impact on costs and schedules of using a monitored retrievable storage facility in conjunction with a repository in tuff at Yucca Mountain.** (Bechtel National, Inc., San Francisco, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 519p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE87012573.

This report documents the results of an engineering study of alternative design concepts for an integrated waste management system involving a repository in tuff at Yucca Mountain, Nevada. Six alternative engineering case studies were developed as a means of comparing various scenarios. Two of the cases involve variations in the design of a repository in a waste management system that does not include a monitored retrievable storage (MRS) facility. Four cases involve alternatives in which a repository receives consolidated spent fuel from an MRS facility located in Tennessee. The waste-handling facilities at the repository are designed to receive and handle up to 3000 metric tons of uranium per year (MTU/y) of spent fuel and an equivalent of 400 MTU/y of defense high-level waste. In each case, different types and quantities of waste are received at the repository because the waste preparation functions assigned to the MRS facility vary from case to case. It is assumed that spent fuel is consolidated in all cases, either at the repository or at the MRS facility. Concepts for consolidating equipment being developed by Westinghouse are used as the bases for the design of the waste-handling facilities. The impact of emplacing unconsolidated spent fuel is not addressed in this study. The variations in repository functions and waste receipts in the six cases result in significant differences in design, operation, cost, and schedule.

38653 **(SAND—85-7210) A thermomechanical analysis of WIPP [Waste Isolation Pilot Plant] DHLW [Defense High Level Waste] experiments: Waste container/borehole interactions.** Brandshaug, T. (RE/SPEC, Inc., Rapid City, SD (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1986. Contract AC04-76DP00789. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012344.

The TiCode-12 container is a waste package design proposed for Defense High Level Waste (DHLW) by Sandia National Laboratories. The TiCode-12 container is cylindrical in shape with a spherical (dome-shaped) top. There is concern about the structural integrity of the dome-shaped top of the TiCode-12 container during the waste isolation period. This report investigates the normal stresses that may be induced on the dome of the TiCode-12 DHLW container, as well as the radial stresses on the cylindrical portion of the container, during the waste isolation period. At the time of emplacement of the TiCode-12 container in a potential repository, the container is lowered into a vertical borehole in the floor of the disposal room. There will be an open space (annulus) between the container and the wall of the drilled borehole. In this study, this annulus was considered open, as well as backfilled with "crushed salt" material and also "a blend of bentonite and silica sand" material. Several different annuli sizes were also considered in this study. Results show that the normal stresses on the dome of the TiCode-12 container are spatially nonuniform and time dependent. The maximum normal stresses predicted are similar for the two APDs considered; however, the time of occurrence of the maxima is significantly different. When backfill material is used, it appears for the conditions studied, an optimum annulus size is approximately 0.05 m. There are indications that an open annulus (no backfill) provides an opportunity to reduce the maximum normal stresses on the dome of the TiCode-12 container, as well as the radial stresses on the cylindrical portion of the container, to magnitudes lower than those predicted when backfill material is present. 17 refs., 58 figs., 7 tabs.

38654 **(SAND—87-0472) Pretest 3-D finite element modeling of the wedge pillar portion of the WIPP [Waste Isolation Pilot Plant] Geomechanical Evaluation (Room G) in situ experiment.** Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012947.

Pretest 3-D finite element calculations have been performed on the wedge pillar portion of the WIPP Geomechanical Evaluation Experiment. The wedge pillar separates two drifts that intersect at an angle of 7.5°. Purpose of the experiment is to provide data on the creep behavior of the wedge and progressive failure at the tip. The first set of calculations utilized a symmetry plane on the center-line of the wedge which allowed treatment of the entire configuration by modeling half of the geometry. Two 3-D calculations in this first set were performed with different drift widths to study the influence of drift size on closure and maximum stress. A cross-section perpendicular to the wedge was also analyzed with 2-D finite element models and the results compared to the 3-D results. In another set of 3-D calculations both drifts were modeled but with less distance between the drifts and the outer boundaries. Results of these calculations are compared with results from the other calculations to better understand the influence of boundary conditions.

38655 **(SAND—87-1809C) Ultrasonic identity data storage and archival system.** McKenzie, J.M.; Self, B.G.; Walker, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870713—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012012.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Ultrasonic seal signature information is being used to determine if an underwater stored spent fuel container has been compromised and can be used to determine if a nuclear material container has been compromised. The Seal PAttern Reader (SPAR) is a microprocessor controlled instrument which interrogates an ultrasonic seal to obtain its identity. The SPAR can compare the present identity with a previous identity, which it obtains from a magnetic bubble cassette memory. A system has been developed which allows an IAEA inspector to transfer seal signature information obtained at a facility by the SPAR to an IAEA-based data storage and retrieval system, using the bubble cassette memory. Likewise, magnetic bubbles can be loaded at the IAEA with seal signature data needed at a facility for comparison purposes. The archived signatures can be retrieved from the data base for relevant statistical manipulation and for plotting. 5 refs.

38656 **(SEPRAD—05/86) Treatment of low-level radioactive liquid waste with uranium using sodium hydroxide.** Silva, S. da; Valente, S.H.; Teixeira, M.V. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Dec 1986. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702557.

This work describes a decontamination method of acid solutions containing UO_2Cl_2. The precipitation of uranium is obtained with NaOH addition to the radwaste solution at ambient temperature. From the experimental data obtained it was observed that in the pH about 4,0 a greater quantify of uranium was precipitated and in pH above 4,0 the precitate was partially solubilized. Nowadays, we study the influence of pH and temperature on the precitation of uranium VI in radwaste solutions with NaOH as well as the compounds obtained in the various stages. This method showed a decontamination factor of about 94,7% and, as a whole, it is viable.

38657 **(SKB-PLAN—86) Cost of the radioactive residues of nuclear power.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jun 1986. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751945.

With a separate appendix.

The calculation of cost for the management and final storage of spent nuclear fuel and radioactive waste is presented. The continuing Research and Development activities are judged to render simplified designs. The existing and planned systems and and plans are as follows: - transport system for radioactive residues - central intermediate storage of spent fuel, CLAB - processing of spent fuel - final storing of long-lived waste - final storing of reactor waste and decommissioning waste, SFR. The total future cost of the Swedish waste management is calculated to be 39 billion SEK from 1987 and 60 years onwards. 5.3 billion SEK have been spent up to the year 1986.

38658 **(SKB-TR—85-08) In-situ one-year burial experiments with simulated nuclear waste glasses.** Hench, L.L.; Spilman, D.; Buonaquisti, T.; Lodding, A.; Werme, L. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). 1985. 123p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751952.

Two simulated nuclear waste glasses were corroded in an in-situ experiment in the Stripa mine up to one year at 90 C and ambient temperature. Changes in compositional in-depth profiles were measured using Fourier transform infrared reflection spectroscopy, SIMS and Rutherford back-scattering. For glass/glass interfaces, both glasses showed depletion of Na, Cs and B, but for the more corrosion resistant glass, the lower depletion is ascribed to the formation of a thin (0.2 nm) coherent and dense outer layer enriched in Mg, Ca, Sr, Ba, Zn-Al and Si, which impedes both ion exchange and network attack of the bulk underneath. For the bentonite interfaces, cation exchange of Ca, Mg, Al and Fe from the bentonite for primarily Na and B is found to produce a glass surface that has three silicate-rich layers. The larger concentrations of M/sup 2+/ and M/sup 3+/ cation and the high silica content of the reaction layers result in a considerably retarded rate of ion exchange after the formation of these layers during the first three months of burial. The granite interfaces showed the lowest rate of attack. This appears to be due to a large increase of Fe and Al within the glass surfaces exposed to granite. The results obtained using Rutheford back-scattering confirm the results obtained using the other techniques for surface analysis. Analysis of burial samples cast in steel mini-canisters show no significant effects associated with the steel canister-glass interface.

38659 **(UNI-SA—172-Rev.1) Data submittal to the DOE integrated data base.** Spence, S.T. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 22 May 1987. Contract AC06-76RL01857. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012224.

The Defense D & D Program includes approximately 220 radioactively contaminated, DOE-owned facilities remaining in the inventory that have been declared surplus to government needs. These facilities are concentrated in seven locations throughout the United States. Defense D & D facilities include such installations as production reactors, fuel reprocessing plants, laboratories, storage tanks, stacks, pipelines, waste treatment systems, solid waste disposal facilities, ponds, cribs, ditches, and areas contaminated by uranium and thorium from mill tailings. The objectives of the Defense D & D Program are to decontaminate these facilities and to eliminate any potential hazards to public health and the environment. The Defense D & D Program was formally established in 1978, and the projected schedule for its current projects is given in Tables 6.6.b and 6.7.b. The predominant wastes in Defense D & D sites are LLW and mill tailings. Some TRU wastes are also involved. The projected waste volumes of these wastes are summarized. The principal Defense D & D projects are listed. Initial characterization of many of the sites has identified the waste volumes that may be soil, building rubble, metal, and miscellaneous materials. Projections for Defense D & D Program waste are updated annually according to the most recent information available. Long-range decommissioning plans were prepared for each Defense D & D site in 1985. The data listed have been updated with new estimated waste volumes.

38660 **(UNI-SA—174) A portable system for decanting and packaging radioactive sludge.** Bogert, S.R.; Weber, J.R. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 16 Dec 1986. Contract AC06-76RL01857. 9p. (CONF-870301—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003840.

From International topical meeting on remote systems and robotics in hostile environments; Pasco, WA, USA (29 Mar 1987).

Several spent fuel storage basins are maintained to support operation of the N Reactor for the US Department of Energy. These basins have systems to filter and demineralize the basin cooling water, but they have no facilities to remove accumulated radioactive sludge on the bottom of the pool. The sludge becomes stirred up during fuel handling operations, thus obscuring vision and increasing the operator radiation exposure in the basin. The portable Sludge Removal System (SRS) was built to remove accumulated sludge, and decant, solidify, and package it in a form suitable for disposal. Because of the flexible design of the SRS, other applications that have been identified include particulate separation from neutralized waste acid and cleanup of outfall structures and solar evaporation ponds.

38661 **(YJT—81-11) Transport in biosphere of radionuclides released from finally disposed nuclear waste - background information for transport and dose model.** Hulmi, R.; Savolainen, I. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Jul 1981. 37p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751939.

An outline is made about the biosphere transport and dose models employed in the estimation of doses due to releases from finally disposed nuclear waste. The models often divide into two parts; the first one describes the transport of radionuclides in those parts of biosphere where the time scale is large (e.g. soil, sea and sea sediment), the second part of the model describes the transport of nuclides in the systems where the time scale is small (e.g. food chains, plants and animals). The description of biosphere conditions includes remarkable uncertainty due to the complexity of the biosphere and its ecosystems. Therefore studies of scenario type are recommended: some values of parametres describing the conditions are assumed, and the consequences are estimated by using these values. The effect of uncertainty in various factors on the uncertainty of final results should be investigated with the employment of alternative scenarios and parametric sensitivity studies. In addition to the ordinary results, intermediate results should be presented. A proposal for the structure of a transport and dose program based on dynamic linear compartment model is presented and mathematical solution alternatives are studied also.

38662 **(YJT—86-32) Hydrogeochemical interpretation of the groundwater at the Haestholmen site, Finland.** Nordstrom, D.K. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Nov 1986. 69p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751940.

This investigation forms a part of the research aimed at marking an assessment of the suitability of rapakivi granite at Haestholmen, an island off the southeastern coast of Finland, for the storage of reactor waste from the Loviisa nuclear power plant. The purpose of this study is to provide preliminary interpretations of the groundwater chemistry based on analyses of groundwater samples taken from several drillholes down to depths of 200 m, as well as other hydrogeological studies made on the site. Chemical analyses of grounfwaters at Haestholmen have demonstrated a fresh-water/saline-water interface at 60-150 m depth, depending on the distance from the coast. The main conclusions from this study

are that (1) the saline water has a seawater origin, (2) the saline water is most likely old Baltic seawater from the early to middle Holocene, (3) this seawater has been chemically modified by at least four processes: calcite precipitation, fluorite dissolution and precipitation, Na-K-Mg-Ca cation exchange and sulfate reduction, (4) the saline groundwaters are not chemically uniform with depth and (5) the saline water chemistry reflects a structural control by the bedrock.

38663 **(YJT—87-01) Loviisa power station - a stress analysis of the reactor waste repository.** Halonen, O. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Jan 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751938.

The low and intermediate level reactor waste produced at the Loviisa Power Station is planned to be buried in the bedrock of Haestholmen island. The rock mass around the final disposal sites has been analysed using a plane strain finite element analysis in two cross sections. All the finite element calculations were performed by using a linearly elastic material model for the rock mass. The resulting principal stresses were used to estimate failure in the rock mass according to Hoek and Brown's empirical failure criterion, which takes into account the quality of the rock mass. The quality of the rock mass in the vicinity of the repository was estimated to be very good (Q=50) according to the NGI-classification. The Q values 40 and 100 were used in the failure analyses. In the failure analyses two extreme initial horizontal stress values were used. Based on the performed failure analyses no failure occurs around the repository when the initial horizontal stress is 5 MPa. At a higher value of horizontal stress (15 MPa), failures occur in the walls of the repository. The failures are usually caused by tensile stress. The stability of the repository is good according to the performed analyses.

38664 **(DP-TR—95) Radioactive waste organic solvent adsorbent.** Ichinose, Shigeo; Kiribayashi, Takehiko. (Savannah River Lab., Aiken, SC (USA); Topy Industries Ltd., Tokyo (Japan)). [1987]. Contract AC09-76SR00001. Translation of Japanese Patent No. Sho 61[1986]-66,198. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012686.

This patent claims a radioactive waste organic solvent adsorbent which consists principally of a synthetic mica which has been obtained by substituting the interlayer ions of a swellable synthetic mica with alkaline earth metal or metal ions by the ion-exchange method. The claimed radioactive waste organic solvent adsorbent consists principally of a hydroxide substituent which has been obtained by substituting interlayer ions with alkaline earth metal or metal ions.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 38608, 38619, 38643, 38644, 39622

38665 **(AAEC/E—638) Environmental survey at Lucas Heights Research Laboratories, 1984.** Giles, M.S.; Dudaitis, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702419.

Results are presented of the environmental survey conducted in the neighbourhood of the Lucas Heights Research Laboratories during 1984. These results are satisfactory. No radioactivity which could have originated from these laboratories was found in samples collected from possible human food chains. All low-level liquid and gaseous waste discharges were within authorised limits. The maximum possible annual dose to the general public from airborne waste discharges during this period is estimated to be less than 0.01 millisieverts, which is one per cent of the limit for long-term exposure that is recommended by the National Health and Medical Research Council.

38666 **(DP-MS—87-88) Special Waste Form Lysimeter Program and waste migration studies at the Savannah River Laboratory.** McIntyre, P.F. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 8p. (CONF-870859—1-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012386.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Special Waste Form Lysimeter Program at the Savannah River Laboratory (SRL) is designed to investigate the leaching performance and radionuclide migration from waste forms containing typical commercial low-level waste under realistic shallow land burial conditions. The purpose is to show that solidification of waste in cement or polymer will provide additional protection for shallow land burial at a humid site. Results to date show that polymer waste forms exhibit superior ^{60}Co and ^{137}Cs retention while cement waste forms show superior ^{90}Sr retention. The purpose of the Waste Migration Program is to obtain a fundamental understanding of the soil-waste-water system of the Savannah River Plant (SRP) burial ground. The defense waste lysimeters are a major part of this program; they are designed to measure the migration of radionuclides and other components from unencapsulated low-level waste. Radionuclide analysis of effluents collected from the 40 defense waste lysimeters during the past year continue to show the presence of low levels of radionuclides. The migration rate is observed to be dependent on the type of waste but not on whether the lysimeter is operating in the saturated or unsaturated mode. The information from both special waste form and defense waste lysimeters is useful for modeling and predicting the future release and migration of radionuclides at a humid site. 5 refs., 2 figs. 2 tabs.

38667 **(RFP—4036) HS and E application technology: Semiannual progress report, July through December 1985.** Smith, L.C.; Deitesfeld, C.A. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 May 1987. Contract AC04-76DP03533. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012301.

Individual projects are included in the data base. (PSB)

0540 Health And Safety

REFER ALSO TO CITATION(S) 38622, 38659, 40111

38668 **(INIS-mf—10913) Report of the Committee of inquiry into a fire which occurred on 18 March 1987 in a radioisotope processing cell, Building 54 at the Lucas Heights Research Laboratories.** (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 25 Mar 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702490.

At about 1745 hours on Wednesday, 18 March 1987 a fire occurred in a small charcoal filter inside a processing cell (hot cell) in Building 54 at the Lucas Heights Research Laboratories (LHRL). This cell was being used to process irradiated uranium to separate the radioactive isotope molybdenum-99. Some radioactive contamination escaped from the hot cell into the operating area and three AAEC officers were found to have minor radioactive contamination on their skin/hair. The majority of the radioactive material released from the fire was trapped by the main filters outside the cell. The total amounts of radioactive noble gas and of radioiodine released to the environment during the week in which the fire occurred were within the normal range of discharge and were 53% and 2.1%, respectively, of the weekly limit authorised by the NSW Department of Health. On the evidence available to it, the Committee concludes that the fire was caused by spontaneous combustion in the charcoal filter used to trap radioactive gases released by the operations in the hot cell; the mechanism causing the fire cannot be clearly established at this stage; no member of AAEC staff, NSW emergency services personnel or the general public suffered, or will suffer, any adverse health effects from radioactivity as a result of the accident.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 38616, 39026, 40312

38669 **(BNL—39984) A safeguards verification technique for solution homogeneity and volume measurements in process tanks.** Suda, S.; Franssen, F. (Brookhaven National Lab., Upton, NY (USA); International Atomic Energy Agency, Vienna (Austria)). 1987. Contract AC02-76CH00016. 11p. (CONF-870713—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012490.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A safeguards verification technique is being developed for determining whether process-liquid homogeneity has been achieved in process tanks and for authenticating volume-measurement algorithms involving temperature corrections. It is proposed that, in new designs for bulk-handling plants employing automated process lines, bubbler probes and thermocouples be installed at several heights in key accountability tanks. High-accuracy measurements of density using an electromanometer can now be made which match or even exceed analytical-laboratory accuracies. Together with regional determination of tank temperatures, these measurements provide density, liquid-column weight and temperature gradients over the fill range of the tank that can be used to ascertain when the tank solution has reached equilibrium. Temperature-correction algorithms can be authenticated by comparing the volumes obtained from the several bubbler-probe liquid-height measurements, each based on different amounts of liquid above and below the probe. The verification technique is based on the automated electromanometer system developed by Brookhaven National Laboratory (BNL). The IAEA has recently approved the purchase of a stainless-steel tank equipped with multiple bubbler and thermocouple probes for installation in its Bulk Calibration Laboratory at IAEA Headquarters, Vienna. The verification technique is scheduled for preliminary trials in late 1987.

38670 **(DOE/DP—0045) Semiannual report on strategic special nuclear material inventory differences.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Safeguards and Security). Jul 1987. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013000.

This twentieth periodic semiannual report of unclassified Inventory Differences (ID's) covers the second six months of fiscal year 1986 (April 1, 1986, through September 30, 1986) for all key Department of Energy (DOE) and DOE contractor operated facilities possessing strategic special nuclear materials. Data for the Rocky Flats and Y-12 nuclear weapons production facilities are not included in the report in order to protect classified nuclear weapons information; however, classified ID data from these facilities receive the same scrutiny and analyses as the unclassified data.

38671 **(DP-MS—87-31) A portable, automated, inexpensive mass and balance calibration system.** Maxwell, S.L. III; Clark, J.P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 9p. (CONF-870713—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012381.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Reliable mass measurements are essential for a nuclear production facility or process control laboratory. DOE Order 5630.2 requires that traceable standards be used to calibrate and monitor equipment used for nuclear material measurements. To ensure the reliability of mass measurements and to comply with DOE traceable requirements, a portable, automated mass and balance calibration system is used at the Savannah River Plant. Automation is achieved using an EPSON HX-20 notebook computer, which can be operated via RS232C interfacing to electronic balances or function with manual data entry if computer interfacing is not feasible. This economical, comprehensive, user-friendly system has three main functions in a mass measurement control program (MMCP): balance certification, calibration of mass standards, and daily measurement of traceable standards. The balance certification program tests for accuracy, precision, sensitivity, linearity, and cornerloading versus specific requirements. The mass calibration program allows rapid calibration of inexpensive mass standards traceable to certified Class S standards. This MMCP permits daily measurement of traceable standards to monitor the reliability of balances during routine use. The automated system verifies balance calibration, stores results for future use, and provides a printed control chart of the stored data. Another feature of the system permits three different weighing routines that accommodate our need for varying degrees of reliability in routine weighing operations. 1 ref.

38672 **(K/ITP—103) UF_6 test loop for evaluation and implementation of international enrichment plant safeguards.** Cooley, J.N.; Fields, L.W.; Swindle, D.W. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 14p. (CONF-870713—22). NTIS, PC A02/MF A01. File Number DE87012239.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A functional test loop capable of simulating UF_6 flows, pressures, and pipe deposits characteristic of gas centrifuge enrichment plant piping has been designed and fabricated by the Enrichment Safeguards Program of Martin Marietta Energy Systems, Inc., for use by International Atomic Energy Agency (IAEA) at its Safeguards Analytical Laboratory in Seibersdorf, Austria. Purpose of the test loop is twofold: (1) to enable the IAEA to evaluate and to calibrate enrichment safeguards measurement instrumentation to be used in limited frequency-unannounced access (LFUA) inspection strategy measurements at gas centrifuge enrichment plants and (2) to train IAEA inspectors in the use of such instrumentation. The test loop incorporates actual sections of cascade header pipes from the centrifuge enrichment plants subject to IAEA inspections. The test loop is described, applications for its use by the IAEA are detailed, and results from an initial demonstration session using the test loop are summarized.

38673 **(K/ITP—104) Investigation of technology for monitoring UF_6 mass flow.** Cooley, J.N.; Moran, B.W.; Swindle, D.W. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 12p. (CONF-870713—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012322.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The applicability of gas flow meters, in-line enrichment monitors, and instruments for measuring uranium or UF_6 concentrations in process streams as a means for verifying declared plant throughput have been investigated. The study was performed to assist the International Atomic Energy Agency in the development of an effective international safeguards approach for aerodynamic uranium enrichment plants. Because the process gas in an aerodynamic enrichment facility is a mixture of UF_6 and H_2, a mass flow measurement in conjunction with a measurement of the uranium (or UF_6) concentration in the process gas is required to quantify the amount of uranium being fed into, and withdrawn from, the cascades for nuclear materials accountability verification. In-line enrichment monitors developed for the US gas centrifuge enrichment plant are found to be applicable only to pure UF_6 streams. Of the five gas flow meters evaluated, the orifice meter and the pitot tube meter are judged the best choices for the proposed applications: the first is recommended for low-velocity gas, small diameter piping; the latter, for high-velocity gas, large diameter piping. Of the six procedures evaluated for measurement of uranium or UF_6 concentration in a mixed process stream, infrared-ultraviolet-visible spectrophotometry is judged to be the best procedure currently available to perform the required measurement. 4 refs., 3 figs., 3 tabs.

38674 **(K/ITP—105) Development of a 20-ton-capacity load-cell-based weighing system for IAEA field use.** Cooley, J.N.; Huxford, T.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 13p. (CONF-870713—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012323.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Based on results of an International Atomic Energy Agency (IAEA) field test of the prototype 20-ton-capacity Load-Cell-Based Weighing System (LCBWS), a modified LCBWS is being config-

ured for routine IAEA field use in verifying the masses of 10- and 14-ton UF_6 cylinders. The modified system is being designed to meet IAEA objectives for accuracy and portability as well as to meet facility operating safety conditions. To best meet these design requirements, a comprehensive survey of commercially available weighing equipment was conducted. Detailed equipment specifications for 25 load cells from 15 manufacturers, for 5 digital crane scales from 3 manufacturers, and for 7 digital weight indicators from 5 manufacturers were compared. The recommended system configuration is a custom-designed load cell in conjunction with a production digital weight indicator. Safety certification of the system by an internationally recognized verification authority is also recommended. Comparison criteria and their effect on the LCBWS design requirements are discussed, and the status of the project is reported.

38675 **(LA—11002-MS) Application of the hybrid x-ray instrument for measurement of thorium-plutonium mixed solutions.** Hsue, S.T.; Eberle, H. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012698.

The hybrid K-edge densitometry/K-x-ray fluorescence instrument constructed by Kernforschungszentrum Karlsruhe, Federal Republic of Germany, is used to measure Th/Pu mixed solutions. We found that the optimal accelerating voltage for measuring these mixed solutions is 130 kV. At optimum operating conditions, the detection limit for thorium is about 25 mg/l. The minimum Th/Pu ratio that can be assayed by the instrument is about 1/1000.

38676 **(SAND—87-0947) The evolution of Interior Intrusion Detection Technology at Sandia National Laboratories.** Graham, R.H.; Workhoven, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012844.

Interior Intrusion Detection Technology began at Sandia National Laboratories (SNL) in 1975 as part of the Fixed Facilities Physical Protection Research and Development program sponsored by the US Department of Energy in connection with their nuclear safeguards effort. This paper describes the evolution of Interior Intrusion Detection Technology at Sandia National Laboratories from the beginning of the Interior Sensor Laboratory to the present. This Laboratory was established in 1976 to evaluate commercial interior intrusion sensors and to assist in site-specific intrusion detection system designs. Examples of special test techniques and new test equipment that were developed at the Lab are presented, including the Sandia Intruder Motion Simulator (SIMS), the Sensor and Environment Monitor (SEM), and the Sandia Interior Robot (SIR). We also discuss new sensors and unique sensor combinations developed when commercial sensors were unavailable and the future application of expert systems.

38677 **(SAND—87-0948) Mobile robot vehicles for physical security.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012843.

A fleet of vehicles is being developed and maintained by Sandia National Labs for studies in remote control and autonomous operation. These vehicles range from modified commercial vehicles to specially constructed mobile platforms and are utilized as test beds for developing concepts in the application of robotics to interior and exterior physical security. Actuators control the vehicle speed, brakes, and steering through manual input from a remote driving station or through some level of digital computer control. On-board processing may include simple vehicle control functions or may allow for unmanned, autonomous operation. communication links are provided for digital communication between control computers, television transmission for vehicle vision, and voice for local control. With these vehicles, SNL can develop, test, and evaluate sensors, processing requirements, various methods of actuator implementation, operator controlled feedback requirements, and vehicle operations. A description of the major features and uses for each of the vehicles in the fleet is provided.

38678 **(SAND—87-1021C) A microprocessor interface for an electronic seal/video surveillance system.** Richter, B.; Stein, G.; Johnson, C.S.; Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1987. Contract AC04-76DP00789. 7p. (CONF-870713—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012018.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

In international nuclear materials safeguards a need for advanced containment/surveillance equipment is anticipated which uses electronic sealing and closed circuit television in a coupled system approach. The paper describes a microprocessor interface for a seal/TV surveillance system, which is being developed within the framework of the bilateral exchange program between the USA and the Federal Republic of Germany. In its basic form, this interface would provide recorded video data of the application and/or removal of the electronic seal, together with annotated video frames containing pertinent seal data. Possible applications are discussed.

38679 **(SAND—87-1039C) The SAVI [Systematic Analysis of Vulnerability to Intrusion] software package.** McAniff, R.J.; Paulus, W.K.; Key, B.; Simpkins, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870713—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012010.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

SAVI (Systematic Analysis of Vulnerability to Intrusion) is a new PC-based software package for modeling physical protection systems (PPS). SAVI utilizes a path analysis approach based on the Adversary Sequence Diagram (ASD) methodology. A highly interactive interface allows the user to accurately model complex facilities, maintain a library of these models on disk, and calculate the most vulnerable paths through any facility. Recommendations help the user choose facility upgrades which should reduce identified path vulnerabilities. Pop-up windows throughout SAVI are used for the input and display of information. A menu at the top of the screen presents all options to the user. These options are further explained on a message line directly below the menu. A diagram on the screen graphically represents the current protection system model. All input is checked for errors, and data are presented in a logical and clear manner. Print utilities provide the user with hard copies of all information and calculated results.

38680 **(SAND—87-1583C) The Modular Integrated Video System (MIVS).** Schneider, S.L.; Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870713—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012013.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Modular Integrated Video System (MIVS) is being developed for the International Atomic Energy Agency (IAEA) for use in facilities where mains power is available and the separation of the Camera and Recording Control Unit is desirable. The system is being developed under the US Program for Technical Assistance to the IAEA Safeguards (POTAS). The MIVS is designed to be a user friendly system allowing operation with minimal effort and training. The system software, through the use of a Liquid Crystal Display (LCD) and four soft keys, leads the inspector through the setup procedures to accomplish the intended surveillance or maintenance task. Review of surveillance data is accomplished with the use of a Portable Review Station. This Review Station will aid the inspector in the review process and determine the number of missed video scenes during a surveillance period.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 38610, 38611, 38878

38681 **(INIS-BR—620) Nuclear importation and exportation - The Brazilian situation.** Coimbra, G.L. (International Nuclear Law Association (INLA), Brussels (Belgium)). 1985. 29p. (In Portuguese). (CONF-850934—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702457.

From NUCLEAR INTER JURA meeting; Constance, F.R. Germany (30 Sep 1985).

The panorama of Brazilian economy emphasizing the measurements adopted by Brazilian government referring to importation and exportation policy is presented. The Brazilian Nuclear Program knows the nuclear trade gives good economic perspective. In the context of importation and exportation policy the laws concerned to nuclear trade transactions, taxes, national organizations responsible by the external trade policy and their attributions are presented. (M.C.K.).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 39373

38682 (AGARD-CP—99, pp vp) **Application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce.** Stewart, P.A.E. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Research into the applications of penetrating radiations or particles for the non-invasive imaging and measurement of events within aero gas turbines on dynamic test at Rolls Royce is discussed. High energy (8 MeV) x rays are used to determine metal component movements for engine performance improvements and integrity configuration. Low energy x rays with high speed cine fluoroscopy have been used to analyze molten metal flows in the turbine blade casting process. Cold neutrons and low energy x rays have been used to analyze two phase flows and oil distribution in the Gem engine oil scavenge system. Positron emitting isotope techniques are being developed to determine fuel and lubrication system dynamics. The images captured by these systems are then processed by digital techniques and pattern recognition and cross-correlation is carried out. Measurements are made from the film and video images using two and three dimensional photogrammetric methods.

38683 **(INIS-mf—10906) X-ray fluorescence (XRF) analysis with Ge-71 excitation source.** Pham Duy Hien; Nguyen Tac Anh; Duong Dinh Thao; Tran Truong. (National Inst. for Nuclear Research, Da Lat (Viet Nam)). [1987]. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702488.

The reactor-produced Ge-71 radioisotope is being used as XRF excitation source for the analysis of light and medium elements up to Cu. The simplicity in its preparation, handling and supply to the analytical centres for routine use overcomes significantly its short lifetime inconvenience (TI/2 = 11.3d). Some typical results of the analysis of crude oils, minor elements in quartz minerals and biological samples demonstrate the advantages of using the Ge-71 exitation source in XRF analysis.

38684 **(JAERI-M—86-105) Development of new rotating target system for 14 MeV neutron irradiation experiments.** Tanaka, Shigeru; Oyama, Yukio; Kusano, Joichi; Ikeda, Yujiro. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 49p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702513.

The RTNS-I type rotating neutron target system has been used at the FNS (Fusion Neutronics Source) facility for four years since the deuteron accelerator system was built in March 1981. Based on a number of items which are found to be improved through operation experience, a new rotating target system has been developed. Main improvements were made on 1) neutron source performance, 2) rotating vacuum sealing, 3) cooling system, 4) swing mechanism, and 5) driving mechanism. Much effort has been devoted especially to developing a reliable rotating vacuum seal, because the diameter of the sealing device of the new target system has to be twice as large as that of the old system. This report describes the details of design and performance test.

38685 **(PPA-CR—11) Nuclear gauging technique for determining roof leaks of D block in PUSPATI complex.** Jaafar Abdullah. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Dec 1986. 11p. (In Malay). NTIS (US Sales Only), PC A02/MF A01 - Nuclear Energy Unit, Kompleks PUSPATI, 43000 Kajang (MY). File Number DE87702539.

Roof leaks due to water infiltration in its structures is one of the civil engineering's most persistent and costly problems. A non-destructive nuclear gauging technique based on neutron scattering and moderation principles is widely used to pinpoint problem areas by measuring moisture concentrations within the roofing structure. A portable sub-surface moisture and density gauge has been used in locating roof leaks of D block in PUSPATI complex. Some of the investigation procedures, data interpretations and results are presented in this paper.

08 HYDROGEN

REFER ALSO TO CITATION(S) 38723

0801 Production

REFER ALSO TO CITATION(S) 39049

38686 **(NP—7770131) Obtaining coke oven gas by alternating pressure adsorption in a carbon molecular sieve.** Brueggendick, H. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Energie-, Verfahrens- und Elektrotechnik). 13 Dec 1985. 323p. (In German). NTIS (US Sales Only), PC A14. File Number DE87770131.

The equilibrium and kinetics of the adsorption and desorption of several components from the gas phase in a molecular sieve containing carbon was experimentally and theoretically examined in this work. The main aim was to supply design data for the adsorptive gas separation process for obtaining hydrogen from coke oven gas. This adsorptive gas separation process, the so-called alternating pressure adsorption process, consists of four stages: adsorption at high pressure level, release and flushing desorption at low pressure level and increase of pressure to the adsorption pressure. Product hydrogen was used as the pressure raising and flushing gas. Purified coke oven gas was selected for adsorptive mixing and a carbon molecular sieve was used as adsorber for hydrogen separation from gases containing hydrogen. The adsorption pressures were in the relevant range of 6 to 15 bar and the flow speed of the gas relative to the empty tube in the adsorption stage was 0.8-1.5 cm/sec.

0802 Storage

REFER ALSO TO CITATION(S) 39198

38687 **(NP—7770132) Gasification experiments to examine surface reactions of hydrogen with metal and alloy films.** Wulz, H.G. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 17 Dec 1984. 176p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770132.

In the context of this dissertation, the volumetric method of S. Wagener was improved at several points so that not only examination of reactions of simple gases on metal films, but also experiments with complex gases on multi-component films and alloy films can be carried out with it. Experiments were carried out with this improved method of measurement, which are intended to give information on the kinetics of hydrogen absorption from hydride

store alloys, which are covered with the oxide layer. Gasification experiments were carried out with hydrogen on the following film samples: a) metal films of Ti, La, Fe, Ni, Mn and Pd without and with oxygen coating, b) covering layers of Fe, Ni, Pd, Mn, Ag and FeTi on a titanium carrier film without and with oxygen coating to examine the effect of a covering layer of a nobler metal on the kinetics of hydrogen absorption, c) oxide films (TiO/sub 2/, La/sub 2/O/sub 3/ and MnO/sub x/) without and with metal covering layer and d) alloy films of FeTi, LaNi/sub 5/, TiMn/sub 2/, TiNi and TiPd without and with oxygen coating.

0808 Properties

REFER ALSO TO CITATION(S) 39183, 40217

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 39171

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 38729, 39315

38688 **(AERE-R—11739) Biological and chemical characterization of landfills (VI). Enderby Warren Landfill, Leicestershire.** Emberton, J.R.; McGahan, D.J.; Worrallo, S.N. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Feb 1987. 26p. H.M. Stationery Office, London, price Pound 5.00.

The landfill site at Enderby Warren will, when completed, contain approximately 3.9 x 10^6 m^3 of predominantly domestic waste at an approximate density of 0.4-1.0 t/m^3. This study indicates that the waste in place in phase III is highly methanogically active and that considerable amounts of landfill gas will be generated over the coming years.

38689 **(BMFT-FB-T—86-145) Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 1. Recovery and utilization plant. Final report.** Rettenberger, G.; Tabasaran, O. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770194.

The report describes in detail the recovery and utilization plant. This plant was subject of an extended research programm concerning the efficiency of the recovery of the gas and the operation of the utilization equipment. The following items are presented: the landfill, the recovery plant, the pumping station, the gas engines and generator set, the supply of greenhouses and the central flaring station. Pt. 2 see report BMFT-FB-T--86-146. Pt. 3 see BMFT-FB-T--86-147. With 36 figs.

38690 **(BMFT-FB-T—86-146) Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 2. Experiences with construction and operation of the gas recovery and utilization plant. Final report.** Rettenberger, G.; Tabadaran, O. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft). Dec 1986. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770137.

The report gives an overview over the experiences which were collected at the gas recovery and utilization plant 'Am Lemberg'. The following items are presented: Design, construction and start up phases, experiences from the start up phase, operation data, description of break down events, experiences from the operation, emissions, extension of the recovery plant and safety property. Altogether the plant was a success and worked well. Pt. 1 published as report BMFT-FB-T--86-145, Pt. 3 as BMFT-FB-T--86-147. With 11 tabs., 14 figs.

38691 (CONF-8511291—, pp 197-213) **Biogas production from animal and plant wastes.** Perwanger, A. (Ingenieurbuero fuer Landtechnik, Zolling, Germany, F.R.). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Purposeful improvement suggestions could be made based on practical comparative studies and associated benchscale tests; these include substrate output increase at substrate dilution, cost-reducing and functionally safe construction of plants with build-on gas cupola and a simple method of biogas production in the final storage tank at concurrent low-cost and high-volume gas storage. The last solution has the advantage that the digestion substrate is treated anaerobically throughout the whole year; N-losses may be less than with open liquid-manure storage and environmentally relevant injunctions concerning odour abatement in farmyard liquid-manure storage may be met absolutely safely at additional utilization of biogas.

38692 (CONF-8610274—Absts., pp 12) **Volatility behaviour of gasolines.** Ecker, A. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38693 (CONF-8610274—Absts., pp 13) **Alternative fuel components, chemical analysis.** Raith, J.; Haas, H. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

38694 **(ETSU-B—1118) Research into the development of prototype units for the production of biogas methane from farm wastes and energy crops.** Etheridge, S.P.; Stafford, D.A. (University Coll., Cardiff, UK). (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1986. 182p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Initial proposals for the research contract ETSU-B1118 included the investigation of the digestion of pig waste and crop materials, by establishing a research station and installing four different types of reactor. The anaerobic digesters selected for study were to include a Plugflow Digester, a Contact Digester, an Anaerobic Filter and a novel design, an Hydraulic Digester. It was hoped to determine the technical feasibility of digesting crop materials and pig waste for the production of energy. Using the data generated, a preliminary economic study was proposed.

38695 **(ETSU-B—1127) Large, farm-scale digester at Pittrichie Pig Unit, Aberdeenshire. Final report on operation and monitoring of the digester.** Hobson, P.N.; Summers, R.; Harries, C.; Feilden, N.E.H.; Thomson, J.; Auld, I. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Dec 1984. 89p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A final report is given on the operation and monitoring of a single-stage, mesophilic, stirred tank digester (Vol. 680 m^3) located at a pig farm in Aberdeenshire. The project was part of the Energy Efficiency Demonstration Scheme and the resulting biogas was burnt in a 283 283 KW boiler or in a spark ignition engine driving a 65 KW alternator. The electricity and heat were used in the piggery and digester. Biologically, the digester was a success but the economics are more doubtful.

38696 **(ETSU-B—1129) Microbiological study into process controlling anaerobic digestion.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; University Coll., Cardiff (UK)). 1987. 31p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Anaerobic digesters operated continuously at both mesophilic and thermophilic temperatures and using both pig waste and fully-defined chemical feeds were studied and compared. Results indicated mesophilic temperatures produced more stable, better performing systems with more rapid equilibration than was the case at thermophilic temperatures. The use of cattle waste to 'seed' thermophilic digesters enabled the digesters to reach stability earlier and effect substrate removal faster than in the absence of such a 'seed'. The most likely explanation for this is the introduction of cellulolytic organisms into the digester which suggests that this class of organisms may be the most thermosensitive (and hence rate-limiting overall) in thermophilic digesters.

38697 **(ETSU-R—41) Potential for biogas on farms in the UK.** Sims, R.E.H.; Richards, K.M. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Department of Energy, London (UK)). Aug 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752795.

This report reviews the research programme commissioned by the Energy Technology Support Unit (ETSU) on behalf of the Department of Energy (ETSU) to investigate the production and utilisation of biogas in the agricultural industry. A series of desk studies, laboratory tests, pilot plant experiments and full-scale digester trials have been undertaken during the last seven years. The results and conclusions are summarised and put into a national context alongside work undertaken by other organisations in the UK. On-farm biogas production from a range of feedstocks is technically feasible but the economic potential remains doubtful. Unless environmental pressures are increased concerning disposal of farm wastes, further research and development into agricultural digestion systems cannot be justified.

38698 **(PNL-SA—13266) The potential energy contribution from medium-Btu gas produced from biomass.** Gerber, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1985. Contract AC06-76RL01830. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012063.

This paper presents a preliminary assessment of the potential market for medium-Btu fuel gas from biomass. It discusses the market niche, current market potential and future market based on an analysis of a limited amount of published information. The analysis indicates that gasification processes have potential technical and economic advantages over other gasification options using biomass or coal in the thermal capacity range between 50 MM and 700 MM Btu/hr. It was also found that a current market of up to 4 1/2 quads (approximately 4 1/2 x 10^{15} kilojoules) annually exists for medium-Btu fuel gas plants in this size range. Further, up to 1 1/2 quads of this potential market exist in states where coal is not expected to be a competitive alternative fuel. Finally, a future market potential for medium-Btu gas from biomass exists in cogeneration applications. 9 refs., 5 figs., 2 tabs.

38699 **(SERI/STR—231-3185) Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks: Subcontract progress report, 1 March 1979-31 August 1979.** Wang, D.I.C.; Cooney, C.L.; Demain, A.L.; Gomez, R.F.; Sinskey, A.J. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012264.

This is a coordinated program to effect the microbiological degradation of cellulosic biomasses and will focus on the use of anaerobic microorganisms which possess cellulolytic enzymes. These studies will attempt to increase the enzyme levels through genetics, mutation and strain selection. In addition, the direct conversion from cellulosic biomasses to liquid fuel (ethanol) and/or soluble sugars by the cellulolytic, anaerobic organism is also within the scope of this program. Process and engineering scale-up, along with economic analyses, will be performed throughout the course of the program. The second area of our major effort is devoted to the production of chemical feedstocks. In particular, three fermentations have been identified for exploration. These are acrylic acid, acetone/butanol and acetic acid. The main efforts in these fermentations will address means for the reduction of the cost of manufacturing for these large volume chemicals.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 38728, 38730, 38731

38700 (CONF-8511291—, pp 64-82) **Ethanol as fuel - state-of-the-art of technology and its relief effect on the EC agricultural market.** Meinhold, K.; Koegl, H. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig, Germany, F.R. Inst. fuer Betriebswirtschaft). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The competitive edge of bioethanol is studied based on the 1985 market conditions. The effect of crop yield levels on bio-ethanol production cost is demonstrated by assuming average yields for ethanol production first and by computing a model version with peak yields for beets and protatoes next. Based on the 1985 competition deficit noted for both single-product market and national economy, the influence of exogenous variables on the competitivity of ethanol on the single-product market and within national economy are studied in a projection for 1990. Basic values are determined at the same time which are required for the assessment of the relative preference of either surplus grain exports, or farmland abandoment, or bio-ethanol production, respectively.

38701 **(DOE/ER/13368—4) Enzymology of acetone-butanol-isopropanol formation: Progress report, June 1, 1985-June 30, 1987.** Chen, Jiann-Shin. (Virginia Polytechnic Inst., Blacksburg (USA)). Jul 1987. Contract FG05-85ER13368. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012471.

The aim of this study is to elucidate the property of enzymes specifically involved in the formation of acetone, butanol, and isopropanol in Clostridium beijerinckii (formerly C. butyricum). Specifically to determine whether one or two alcohol dehydrogenases were involved in the formation of butanol and isopropanol and to identify and characterize the enzyme converting acetoacetyl CoA to acetoacetate. Studies on butyraldehyde dehydrogenase and acetoacetate decarboxylase of C. beijerinckii were started. With the development of assays for these enzymes, we investigated whether activities of these enzymes are coordinately expressed during the metabolic transition and whether enzyme activities are better markers for the onset of the transition. The long-term goals of the study are to achieve a positive control of the onset of the metabolic transition, to prevent degeneration of producing strains, and to be able to regulate the production of butanol and isopropanol. 5 refs., 5 figs., 1 tab.

38702 **(SERI/STR—231-3135) Economic feasibility study of an enzymatic hydrolysis-based ethanol plant with prehydrolysis pretreatment: A subcontract report.** (Chem Systems, Inc., Tarrytown, NY (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 238p. NTIS MF A01; 2; GPO Dep. File Number DE87001190.

This report presents an economic feasibility study of an enzymatic-hydrolysis-based ethanol plant with prehydrolysis treatment. Dilute-acid prehydrolysis had been determined to be one of the most economic pretreatments for enzyme hydrolysis. A Midwest site was selected for the ethanol facility; screening parameters were ethanol consumption patterns, gasoline demand, tax laws, and wood resources. The facility is designed to produce 25 million gallons per year of fuel-grade ethanol from mixed hardwood chips, with furfural and carbon dioxide as major by-products. It was determined that an enzymatic hydrolysis based ethanol plant using prehydrolysis pretreatment is a viable process concept. 14 refs., 4 figs., 76 tabs.

38703 **(SERI/STR—231-3136) Fuel grade ethanol by solvent extraction: Final subcontract report.** Tedder, D.W. (Georgia Inst. of Tech., Atlanta (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001192.

This report summarizes final results for ethanol recovery by solvent extraction and extractive distillation. At conclusion this work can be summarized as ethanol dehydration and recovery dilute fermentates is feasible using liquid/liquid extraction and extractive distillation. Compared to distillation, the economics are more attractive for less than 5 wt % ethanol. However, an economic bias in favor of SEED appears to exist even for 10 wt % feeds. It is of particular interest to consider the group extraction of ethanol and acetic acid followed by conversion to a mixture of ethanol and ethyl acetate. The latter species is a more valuable commodity and group extraction of inhibitory species is one feature of liquid/liquid extraction that is not easily accomodated using distillation. Upflow immobilized reactors offer the possibility of achieving high substrate conversion while also maintaining low metabolite concentrations. However, many questions remain to be answered with such a concept. 135 refs., 42 figs., 61 tabs.

38704 **(SERI/STR—231-3139) Economic feasibility study of an acid-based ethanol plant: A subcontract report.** (Stone and Webster Engineering Corp., Boston, MA (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87001188.

This work presents an economic feasibility study of an acid-hydrolysis-based ethanol plant. The site chosen was in Hawaii because of eucalyptus resources and liquid fuel market conditions. A plant site of 15 million gallons per year of denatured alcohol was selected. The base-case design used current commercial technology whereever applicable. The method was determined to be technically feasible, given significant by-product credits. R and D areas identified were pentose conversion to ethanol, lignin utilization, increase in reactor yield, and increased solids concentration. 56 refs., 33 figs, 23 tabs.

38705 **(SERI/STR—231-3141) Economic feasibility study of a wood gasification-based methanol plant: A subcontract report.** (Stone and Webster Engineering Corp., Boston, MA (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87001187.

This report presents an economic feasibility study for a wood-gasification-based methanol plant. The objectives were to evaluate the current commercial potential of a small-scale, wood-fed methanol plant using the SERI oxygen-blown, pressurized, down-draft gasifier technology and to identify areas requiring further R and D. The gasifier gas composition and material balance were based on a computer model of the SERI gasifier since acceptable test data were not available. The estimated capital cost was based on the Nth plant constructed. Given the small size and commercial nature of most of the equipment, N was assumed to be between 5 and 10. Only large discrepancies in gasifier output would result in significant charges in capital costs. 47 figs., 55 tabs.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 38715, 38717, 38718, 39472, 39570

38706 (CONF-8511291—, pp 83-96) **Mechanical processing of dry biomass - state-of-the-art of technology, energy consumption and cost (chopping, grinding, briquetting).** Claus, H.G. Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The mechanical processing of dry biomass, in particular of wood and straw, comprises cutting, punding, crushing, grinding and shredding. These basic operations can be implemented either singly or in combination depending on the properties of the material and on the requirements made on the intermediate and finished products. The paper presents and compares the chopping machines and briquetting presses available on the market. In addition, the paper discusses spread-heap composting of chopped straw, combustion of compressed straw and chemical straw processing for improving its digestability for ruminants.

0906 Gaseous Waste Fuels

REFER ALSO TO CITATION(S) 38688

13 HYDRO ENERGY

1302 Site Geology And Meteorology

REFER ALSO TO CITATION(S) 38708

1306 Environmental Aspects

38707 **(AD-A—179787/7/XAB) Comparative effects on trout habitat of hydropower modification with and without reregulation in the Cumberland River below Wolf Creek Dam, Kentucky. Final report.** Curtis, L.T.; Nestler, J.M.; Martin, J.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Mar 1987. 179p. (WES/MP/EL—87-2). NTIS, PC A09/MF A01.

The U.S. Army Engineer District, Nashville regulates flows in the Cumberland River at Wolf Creek Dam to provide for hydropower generation and flood control. To meet future demands for power in the region, the ORN is considering optimizing the generating capability at Wolf Creek Dam by both uprating existing turbines and adding more generating capability. Reregulation of the increased releases from Wolf Creek Dam is under consideration to alleviate the flow fluctuations associated with the upgrade. This report describes and quantifies the effects on trout habitat of hydropower modification and peaking operation at Wolf Creek Dam on trout habitat in the reach of the Cumberland River between Wolf Creek Dam and the site of the reregulation dam both with and without reregulation. The results of this comparison indicate that reregulation will generally have a beneficial impact on trout habitat, primarily because the backwater effects caused by the reregulation dam reduce the water velocities associated with peak discharge.

1307 Power-conversion Systems

38708 **(EPRI-AP—5273) Design guidelines for pressure tunnels and shafts: Final report.** Brekke, T.L.; Ripley, B.D. (California Univ., Berkeley (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 176p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920445.

The purpose of this report is to serve as a guideline for the planning and design of pressure tunnels and shafts. Both unlined and lined waterways are considered. A review of existing approaches and procedures used in the United States and abroad form the basis for the guideline. In addition, a summary of numerous case histories is included, with particular attention to cases of incident or failure. The emphasis is on the geotechnical aspects of planning and design of high pressure systems. The major topics discussed are operational requirements, site characterization, layout considerations, lining selection and design, and leakage control. 188 refs., 35 figs., 22 tabs.

14 SOLAR ENERGY

38709 **(SERI/MR—260-3124) R and D technology transfer: Annual report, fiscal year 1986.** (Solar Energy Research Inst., Golden, CO (USA)). Jan 1987. Contract AC02-83CH10093. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011804.

Because technology transfer is an essential element of SERI's mission, it is a part of every research program and a responsibility of every researcher and manager. As this report illustrates, the bulk of ongoing technology transfer activities take place in the research divisions. The study also generated, for the first time, an extensive compilation of significant data on the industry, providing a valuable resource for economic studies and market analyses. This study provides a better understanding of the "market" for new technologies developed through SERI's research.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 38735, 38736, 38737, 38738, 38743

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 38732, 38733

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 38691, 38694, 38695, 38696, 38697, 38698, 38699, 38700, 38702, 38703, 38704, 38706, 39144, 39226, 39286, 39670

38710 **(AD-A—179773/7/XAB) Semiconductor eutectic solar cell. Technical report (Final), November 1976-December 1978.** Yue, A.S.; Yu, J.G. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Dec 1986. 115p. (UCLA-ENG—8008). NTIS, PC A06/MF A01.

Two-phase semiconducting eutectics are potential device materials. Of these, the SnSe-$SnSe_2$ eutectic was chosen for studies in detail because it consists of multi p/n layers of SnSe and $SnSe_2$ semiconductors. Since plasma frequency has not been detected in its infrared reflectance spectrum up to 40 micrometers of wavelength, it suggests that the SnSe-$SnSe_2$ eutectic is a nondegenerate semiconductor. As-grown $SnSe_2$ single crystals have hexagonal crystallographic structure and show n-type conductivity. Polycrystalline SnSe and $SnSe_2$ films have been successfully prepared in vacuum using a close-space-vapor transport technique.

38711 (CONF-8511291—, pp 1-30) **Potential of biomass.** Meliss, M. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

This assessment of the biomass potential of the Federal Republic of Germany differentiates between residue/waste biomass and energy plantations. The author's assessment attempts to evaluate maximally usable energy potentials based on today's production figures from agriculture and forestry and their corresponding utilization structures, and on the annual amount of wastes, refuse and sewage sludge. In total, there are some 70 mil. t of organic dry substance with an energy content of some 46 mil. t coal units. Technical methods allow to use but a certain part of these wastes. A profusion of individual techniques for the conversion of biomass to usable secondary energy carriers are known; however, in the FRG, waste conversion is best implemented by combustion, biogas production and, to a lesser degree, by wood gasification.

38712 (CONF-8511291—, pp 31-41) **Initial experience with tests performed for short-rotation production and utilization of forestry biomass.** Dimitri, L. (Hessische Forstliche Versuchsanstalt, Hann Muenden, Germany, F.R.; Forschungsinstitut fuer Schnellwachsende Baumarten, Hann Muenden, Germany, F.R.). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The economic success of short-rotation cultivation of fast-growing free species depends from stand quality, plant material, cultivation and havesting technique, and application. For energy production, wood chops were combusted either directly or else were used as base material for wood gasification. Their calorific value is within the range found for other European tree species.

38713 (CONF-8511291—, pp 42-55) **Vegetable oil as motor fuel - production and utilization - experience gained in developing countries and in Europe.** Zaske, J. (Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., GTZ, Eschborn, Germany, F.R.). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The utilization of renewable raw materials, espec. the production of biofuels, is of a particular significance. Whereas biofuels cannot (yet) compete with diesel and petrol in the industrialized countries, they may do so in specific regions or Third World countries. Rural regions with their generally weak infrastructure, lack of power supply and extreme distance to markets suggests the substitution of mineral oil derivatives by vegetable fuels; however, this requires either matching of engine technology of these novel fuels or matching of the fuels to available engines. Vegetable or plant oils, in particular if they just require slime removal and no other processing, represent a fuel easy to produce in a decentralized way; however, these oils require a specific engine technology which exists in the ELKO principle. Antechamber engines (older versions) can be operated with plant oils, too.

38714 (CONF-8511291—, pp 56-63) **Plant oil as fuel - production and processing of plant oils and by-products to fuels.** Apfelbeck, R. (Technische Univ. Muenchen, Freising, Germany, F.R. Landesanstalt fuer Landtechnik Weihenstephan). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Our search for alternative liquid engines fuels suggests the production of methanol, ethanol and plant oil. Plant oil production has major advantages over the other two renewable fuels concerning energy density, preservation and processing. World-wide there are a great number of site-specific oil plants available for production. The example of rape cultivation demonstrates that the obtainable energy equivalent of some 3,000 kg fuel oil/diesel will have to be used bivalently as both a liquid engine fuel and as a solid combustion fuel. In addition, this will produce storable protein feed stuffs as a by-product.

38715 (CONF-8511291—, pp 97-107) **Highly compacted biomass - its potential and limits as a fuel with special respect to its profitability in single farm utilization.** Stuermer, H. (Technische Univ. Muenchen, Freising, Germany, F.R. Lehrstuhl fuer Angewandte Landwirtschaftliche Betriebslehre). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The paper demonstrates the technical feasibility of compacting/compressing biomass to produce briquets or pellets by means of various press-types. Suitable materials for pressing are wood, straw, paper, peat, bagassis, rice and peanut peels. The piston press is the press typically used for briquetting. As a rule, manually fed small-sized furnaces are used for combustion. Pellets are particularly suited to automatic combustion. Matrix presses are used most for pelleting. Profitability criteria involve process cost and sales potential at cost-effective prices in competition with conventional fuels.

38716 (CONF-8511291—, pp 108-121) **Thermal processing of biomass: Carbonization, pyrolysis - state-of-the-art and applications.** Hofstetter, E.M. (Bio-Energy G.m.b.H. und Co. Technologietransfer K.G., Isen, Germany, F.R.). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Biomass carbonization allows to convert plant residues like wood wastes, saw mill wastes, peels of peanuts, coffee beans and rice, etc., to highly valuable energy carriers like coal and tar oil. Whereas this technology is applied only in the production of charcoal for barbecues, and other leisure activities in Central Europe, thus contributing to the energy supply to but a limited extent, it may well contribute to the fuel supply of the populations in developing countries. In addition it will allow to kerb the environmentally detrimental use of brush wood for the production of charcoal by means of conventional techniques.

38717 (CONF-8511291—, pp 143-168) **Heat production from straw and wood - state-of-the-art and cost.** Strehler, A. (Technische Univ. Muenchen, Freising, Germany, F.R. Landesanstalt fuer Landtechnik Weihenstephan). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

The incineration of biomass for heat generation is the simplest way of biomass utilization for energy purposes from a technical point of view. Its general application requires to improve technological methods mainly in terms of low pollutivity, performance constancy, controllability and price effectiveness. The biomass potential of wastes with some 5 mil. t oil equivalent provide a sufficient market edge to produce high-quality firing systems and to broaden the fuel supply in energy carrier production for unburdening the agricultural market. The technology for biomass combustion has been further developed in a great variety. Individual furnaces, small boilers, large boilers with batch or continuous fuel feed are suitable depending from fuel type. Batch-type fuelling requires combustion to be subdivided into primary and secondary combustion. The profitability of biomass combustion largely depends on site factors and oil prices.

38718 (CONF-8511291—, pp 169-180) **Results and experience obtained by research and development projects for straw and wood combustion.** Kraus, U. (Technische Univ. Muenchen, Freising, Germany, F.R. Landesanstalt fuer Landtechnik Weihenstephan). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Functional safety, energy utilization of the fuel, pollutivity and profitability of firing systems are assessed to gain practical experience with new technologies. For wood combustion, 16 mechanical-feed wood-chop-fuelled firing systems for heating farm buildings featuring various types are listed; for straw combustion, 12 systems are listed including straw-bale combustion and 8 mechanically or pneumatically fueled systems operating with shredded straw. Boiler heat output ranges between 70 and 1,000 KW. In conclusion, the firing systems of different combustion facilities of identical heat output are compared.

38719 (CONF-8511291—, pp 181-196) **Power from biomass - a survey with special reference to wood gasifiers.** Schulze Lammers, P. (Technische Univ. Muenchen, Freising, Germany, F.R. Landesanstalt fuer Landtechnik Weihenstephan). Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Biomass gasification produces a combustible gas which can be used as engine fuel. In addition, all gasifiers produce liquid by-products like water, tar and organic acids which render the application of gasifier technology more difficult. Various gasifier systems are available in the FRG; these include solid-bed gasifiers, fluidized-bed processes and multi-stage gas production processes. The application of gas generators for power generation or for prime-mover driving appears to be more promising in countries with less extended national power grids than in industrialized nations.

38720 **(DOE/SR/01052—9) Evaluation of fusiform rust resistant pines: Progress report, period ending December 1984.** Powers, H.R. Jr. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). 5 Dec 1985. Contract AI09-78SR01052. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012150.

Heavy metal accumulation in various plant tissues was studied as a result of sludge application prior to planting. There is a notable concentration of the heavy metals such as lead, chromium, nickel, and cadmium in needles treated with sludge. In addition the effects of sulfur dioxide and ozone were studied. The results indicate that treatment with O_3 alone resulted in more reduction in shoot growth than any of the other treatment although it did not cause significantly more growth reduction than SO_2 plus ozone. Both of these treatments were significantly more damaging than either the SO_2 alone, or the unfumigated control.

38721 **(DOE/SR/01052—10) Evaluation of fusiform rust resistant pines: Final report for the period September 1, 1978 to December 31, 1985.** Powers, H.R. Jr. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). 5 Dec 1985. Contract AI09-78SR01052. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012151.

The resistance of loblolly and slash pines to fusiform rust (Cronartium fusiforme) was studied. There was a marked difference in rust resistance between the five seed sources of loblolly pine planted on the SPR. After several growing seasons there was little infection on Texas and Arkansas sources and only light infection on Louisiana and Maryland sources compared to susceptible controls. Greenhouse tests indicated the Maryland source was most resistant. Trees from fusiform resistant and susceptible seed sources were treated with 300 or 600 pounds of N per acre via a municipal sludge. The 300-pound application produced the most growth. Level of sludge application had no influence on fusiform infection. There was found to be no direct correlation between levels of rust resistance in 20 loblolly pine families and their visible injury following treatment with SO_2 and SO_3.

38722 **(EUR—10015) Development of a CdSe thin film solar cell.** Rickus, E.; Jaeger, K.H.; Luke, U.; Fussnegger H. (Commission of the European Communities, Luxembourg). 1985. 74p. NTIS (US Sales Only), PC A04. File Number DE87752651.

Investigations and optimisations on the CdSe thin film solar cell resulted in an enhancement of the photovoltaic AM1 efficiency to peak values above 7 percent on 0.6 cm active area. This efficiency is about 1 percent higher than was expected in the proposal and was mainly achieved by the enhancement of the short circuit current density, which amounts to around 80 percent of the theoretical maximum value. Further enhancements are possible by fabricating the cell on the basis of the ternary compound CdSe/sub x/Te/sub 1-x/. The investigations concerning the cells' stability and considerations about their production costs demonstrate that CdSe thin film solar cells may have a significant potential for terrestrial use as stable, low-cost solar cells. The results, which were achieved with relatively little effort compared to other solar cell developments, give reason to expect fast further progress in reaching this goal.

38723 **(NP—7770198) Project 'Solar hydrogen'. Solar hydrogen production, storage, and uses.** (Solar-Wasserstoff-Bayern G.m.b.H., Muenchen (Germany, F.R.)). Dec 1986. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87770198.

The report describes the goals, the system layout, the measuring programme, the site, the construcional measures, the time schedule, the project organisation and management, the cost and the financing scheme.

38724 **(NP—7770206) Solar cells for space travel and terrestrial application.** (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (Germany, F.R.)). 1980. 9p. (In German and English). NTIS (US Sales Only), PC A2. File Number DE87770206.

Until the first oil crisis in 1973, solar cells were hardly to be found except in space travel. As a result of the increase in efforts to use solar energy for terrestrial purposes as well, which set in after the oil crisis, the silicon solar cell spread considerably throughout the world. A general view shows the extent to which a large German manufacturing company has intensified its investments and research since then. Successes in solar cell technology for space applications are listed (using solar energy for satellites), and particular emphasis is placed on the continuous increase of solar cell efficiency from 10% in 1960 to 16% at the present, and on the considerable increase of output per cell mass. Details are given of BSR technology (utilisation of selective reflex properties of a silicon disc metallised on the back) and NR technology (utilisation of adsorption properties of a silicon surface specially structured by chemical treatment). A report is also made on the present level of development of the silicon cell which can be used terrestrially and the manufacture of large-surface, non-crystalline silicon solar cells with high-level efficiency. (HWJ).

38725 **(SAND—87-7008) The integration of 1990s thin-film technologies into photovoltaic system design.** Stolte, W.J. (Bechtel Group, Inc., San Francisco, CA (USA). Research and Development). May 1987. Contract AC04-76DP00789. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011581.

This report addresses the integration of 1990s timeframe thin-film flat-plate modules into system design. It includes the results of an industry survey to determine the characteristics of such future thin-film modules and the characteristics of a range of postulated module configurations. Impacts on balance-of-plant designs were evaluated for fixed, single-axis tracking and dual-axis tracking arrays in utility-scale plants using postulated low-voltage thin-film module counterparts of present crystalline silicon modules. Intermediate and high-voltage modules more suited to thin-film technology were used in developing plant design modifications to optimally incorporate such future modules. Blocking diode placement, the economics of replacing failed modules, dc field wiring optimization, and additional topics were also addressed. No mechanical or structural design changes were found to be necessary to integrate thin-film modules into existing system designs. Changes to the electrical designs mostly involved slight changes to equipment ratings or panel wiring and were considered to be insignificant. Cost impacts were minor, on the order of one cent per watt. It was found that blocking diode placement should be determined experimentally by the manufacturers, with calculations used only as a guide.

38726 **(SERI/PR—211-3115) Photovoltaic Program Branch: Annual report, FY 1986.** (Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 224p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87001162.

This report summarizes the progress of the Photovoltaic Program Branch of the Solar Energy Research Institute from October 1, 1985, through September 30, 1986. The branch is responsible for the management of the subcontracted portion of SERI's PV Advanced Research and Development Project. In FY 1986, this included more than 60 subcontracts with a total funding of approximately $12 million. The technical sections of the report cover the main areas of DOE/SERI's subcontracted program: the Amorphous Silicon Research Project, Polycrystalline Thin Films, High-Efficiency Crystalline Cells, the New Ideas Program, and the University Participation Program. A list of active subcontracts and a bibliography of relevant publications are also included. The technical summaries of each subcontracted program area provide a discussion of approaches, major accomplishments in FY 1986, and future research directions.

38727 **(SERI/STR—211-3147) SERI PV AR and D University participation program: Annual subcontract report, FY 1986.** Bedair, S.M.; Taylor, P.C.; Gal, M.; Williams, G.A.; Ohlsen, W.D.; Dapkus, P.D.; Bube, R.H.; Daly, J.T.; Gerritsen, H.J.; Crisman, E.E. (North Carolina State Univ., Raleigh (USA); Utah Univ., Salt Lake City (USA); University of Southern California, Los Angeles (USA); Stanford Univ., CA (USA); Brown Univ., Providence, RI (USA)). Apr 1987. Contract AC02-83CH10093. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001174.

This report contains the first annual technical progress reports of the five initial university photovoltaic research centers. These five projects were started under a competitive procurement for the Solar Energy Research Institute. These progress reports include the following studies: "New Approach for High Efficiency Solar Cell by MOCVD" (North Carolina State University); "Electronic Processes in Thin film PV Materials" (University of Utah); "Low Temperature MOCVD Growth Processes for High Efficiency Solar Cells" (University of Southern California); "Ion Beam Doping of II-VI Compounds During Physical Vapor Deposition" (Stanford University); and "Rapid Liquid Phase Epitaxy of III-V Semiconductors" (Brown University).

38728 **(SERI/STR—231-3137) Acid hydrolysis and pretreatment of lignocellulosic substrates: Final subcontract report.** Grethlein, H.; Converse, A.; VickRoy, J.; Holland, J.; Grous, W.; Ward, J. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering; Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001191.

This report presents findings on acid hydrolysis and pretreatment of lignocellulosic substrates. Acetone was incorporated as a major fluid component to promote the hydrolysis of wood in the presence of dilute sulfuric acid and water. The use of a novel cyclone reactor design was explored through computer simulation and prototype construction. An investigation of using sulfur dioxide near the critical point as the reaction medium for cellulose hydrolysis was conducted. Pretreatment by steam explosion for enhanced enzymatic hydrolysis was studied on poplar. 26 refs., 7 figs., 1 tab.

38729 **(SERI/STR—231-3177) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 March 1984-28 February 1985.** Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 153p. NTIS, PC A08. File Number DE87001197.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic celluloytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars and Clostridium thermosaccharolyticum, a thermophilic anaerobe which produces high concentrations of ethanol from both hexoses and pentoses. These studies focus on the use of C. thermocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to liquid fuel. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. 9 refs., 9 figs., 9 tabs.

38730 **(SERI/STR—231-3178) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 March 1983-29 February 1984.** Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001198.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic cellulolytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars, and Clostridium thermosaccharolyticum, a thermo anaerobe which produces high concentrations of ethanol from both hexoses and pentoses. The proposed studies will focus on the use of C. thermocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to the liquid fuel, butanol. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. The effort on butanol will extend the concept of direct fermentation to the production of this liquid fuel. 14 refs.

38731 **(SERI/TP—231-3161) Simultaneous saccharification and fermentation of lignocellulose: Process evaluation.** Wright, J.D.; Wyman, C.E.; Grohmann, K. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 17p. (CONF-870523—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001194.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

Simultaneous saccharification and fermentation (SSF) processes for producing ethanol from lignocellulose are capable of improved hydrolysis rates, yields, and product concentrations compared to separate hydrolysis and fermentation (SHF) systems, because the continuous removal of the sugars by the yeasts reduces the end-product inhibition of the enzyme complex. Recent experiments using Genencor 150L cellulase and mixed yeast cultures have produced yields and concentrations of ethanol from cellulose of 80% and 4.5% respectively. The mixed culture was employed because B. clausenii has the ability to ferment cellobiose (further reducing end-product inhibition), while the brewing yeast S. cerevisiae provides a robust ability to ferment the monomeric sugars. These experimental results are combined with a process model to evaluate the economics of the process and to investigate the effect of alternative processes, conditions, and organisms. 36 refs., 9 figs., 2 tabs.

38732 **Identification of training and emergency-planning needs through job-safety analysis.** Veltrie, J. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **19**: No. 3/4, 337-343(Jan 1987). (CONF-8601110—).

From SERI photovoltaics safety conference; Lakewood, CO, USA (16 Jan 1986).

Training and emergency-planning needs within the photovoltaic industry may be more accurately determined through the performance of detailed job-safety analysis. This paper outlines the four major components of such an analysis, namely operational review, hazards evaluation, personnel review and resources evaluation. It then shows how these may be developed into coherent training and planning recommendations, for both emergency and non-emergency situations.

38733 **Development and implementation of an effective emergency-preparedness plan.** McConnell, R.J. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **19**: No. 3/4, 345-353(Jan 1987). (CONF-8601110—).

From SERI photovoltaics safety conference; Lakewood, CO, USA (16 Jan 1986).

Job-safety analyses and similar programs are useful means of identifying potentially hazardous operations within the photovoltaics and other industries. Even after such programs there remains a need for effective emergency-preparedness plans (EPPs), and this paper describes the major steps in developing and implementing such plans. EPPs are directed ultimately towards the protection of people and the environment in the event of an emergency, the limitation of any resulting damage and the provision of adequate, correct information to all those affected. These goals can be achieved through identification of potential hazards and the strategic provision of resources and communications, followed by thorough programs of training, testing, and review.

38734 **Effect of ground reflectivity and ground offset on the row-to-row shading of flat plate solar arrays.** Goswami, D.Y.; Barshooi, M.; Stefanakos, E.K. (North Carolina A and T State Univ., Greensboro, NC). pp 720-726 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

For photovolatic arrays arranged in multiple photovoltaic modules, each row, except the first, will be shaded by the row in front of it. To allow direct (beam) radiation to reach a south facing photovoltaic (PV) row located behind another row sufficient spacing must be provided. However, even if the minimum spacing is provided, the front row will prevent some ground reflected and diffuse radiation from reaching the second row. This study studies the effect of ground offset and the ground reflectivity. It is found from this study that if the array is offset from the ground, the decrease is even smaller. It is also found that the percent decrease in total solar radiation increases with the ground reflectivity. However, even for a ground reflectivity of 0.8 (snow cover) the difference is less than 3%.

38735 **Solar radiation topical overview.** Hulstrom, R.L. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 179-187(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

The purpose of this paper is to present an overview of solar radiation (insolation) research and assessment as it pertains to the photovoltaic (PV) solar-energy-conversion technology and industry. In addition, this paper is intended as a framework for and introduction to the specific papers that make up the Solar Radiation Session of the Photovoltaics and Insolation Measurements Workshop. This presents an overview consisting of four fundamental areas: (1) resource data; (2) measurements and monitoring; (3) models; (4) instrumentation. More detailed information for each area will be given in other papers that are part of the Solar Radiation Session.

38736 **Characteristics of network measurements.** Flowers, E.C.; Maxwell, E.L. (National Oceanic and Atmospheric Administration, Boulder, CO; Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 205-212(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

By means of the technique that has become known as the component method, an accurate measurement of global radiation during cloudless conditions is obtained with an absolute cavity radiometer (direct component) and a disk shaded pyranometer which possesses good linearity and spectral characteristics (diffuse component). The accuracy attainable is about +-0.3% relative accuracy over a wide range of solar angles with a bias error of about 0.7%, the bias error being applicable to the absolute accuracy. With this global measurement the voltage outputs of other pyranometers can be evaluated as a function of solar position to determine the instrument response to cloudless sky global radiation.

38737 **Spectral solar irradiance models and data sets.** Riordan, C.J. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 223-232(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

This paper reviews the nature of spectral-irradiance variations and their impact on PV device performance, the models and data sets used to characterize spectral irradiance variations, and issues related to the specification of spectral irradiance conditions for PV device performance analyses.

38738 **Spectral solar irradiance instrumentation and measurement techniques.** Cannon, T.W. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 233-241(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

Quality spectral measurements are of great value in any PV-device testing program and in the verification of models and generation of empirical data sets for predicting PV system performance. The integrity of the data is ensured by attention to detail in the configuration, characterization, calibration, and operation of the spectroradiometers.

38739 **Translation of device performance measurements to reference conditions.** Osterwald, C.R. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 269-279(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

Translation of photovoltaic performance measurements is required when a measurement is made under conditions different from those specified in standard measurement procedures. These specifications can be categorized into three areas: the device temperature at the time of measurement; the total incident irradiance level; and the spectral distribution of the incident irradiance. If these three conditions are identical to those specified in the standard measurement procedures, then no translation is required. However, because in practice the standard measurement conditions can be very difficult (and expensive) to achieve, one or more of these three conditions will generally be different and translation is then necessary. In general, the method used for translation is to know how a device responds to different conditions, measure the difference at the time the performance is determined, and correct the performance measurement to the standard conditions.

38740 **Photovoltaic-concentrator-cell measurement methods.** Gee, J.M.; Hansen, B.R. (Sandia National Labs., Albuquerque, NM). *Solar Cells;* **18**: No. 3/4, 281-288(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

The basic procedure used to measure the performance of concentrator cells is presented. The high irradiances and currents make testing of concentrator cells more complex than testing one-sun cells. Determination of the irradiance is the most difficult problem. Using the I/sub sc/ to determine the irradiance has many advantages if the I/sub sc/-irradiance relationship is independently known. It is frequently assumed that the I/sub sc/ is linear with irradiance. Linearity is a good approximaton with conventional silicon cells. However, for cell materials other than silicon and for nonconventional silicon-cell designs, the I/sub sc/-irradiance relationship will need to be independently determined. A procedure for comparing the I/sub sc/-irradiance relationships of two cells is also presented.

38741 **PV concentrator array field-performance measurement.** Maish, A.B. (Sandia National Labs., Albuquerque, NM). *Solar Cells;* **18**: No. 3/4, 363-371(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

This paper discusses the procedures used to measure concentrator module and array performance at Sandia National Laboratories. It describes the method used to characterize efficiency as a function of two independent variables, direct normal insolation (DNI) and the heat-sink temperature. It then investigates the uncertainty in the measured efficiency due to the choice of independent variables. The paper concludes with a review of some of the factors that must be considered in a model that uses the array-efficiency equation to estimate annual system energy production.

38742 **Photovoltaic array performance simulation models.** Menicucci, D.F. (Sandia National Labs., Albuquerque, NM). *Solar Cells;* **18**: No. 3/4, 383-392(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

The experience of the solar industry confirms that, despite recent cost reductions, the profitability of photovoltaic (PV) systems is often marginal and the configuration and sizing of a system is a critical problem for the design engineer. Construction and evaluation of experimental systems are expensive and seldom justifiable. A mathematical model or computer-simulation program is a desirable alternative, provided reliable results can be obtained. Sandia National Laboratories, Albuquerque (SNLA), has been studying PV-system modeling techniques in an effort to develop an effective tool to be used by engineers and architects in the design of cost-effective PV systems. This paper reviews two of the sources of error found in previous PV modeling programs, presents the remedies developed to correct these errors, and describes a new program that incorporates these improvements.

38743 **Summary of the photovoltaics and insolation measurements workshop panel results.** Hulstrom, R. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 393-395(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

This paper presents a summary of the results of the three panels, consisting of needs and recommendations. It is not the minutes of the panels. In addition, this paper does not do justice to the very beneficial and interesting discussions and exchange of thoughts/ideas that the panels precipitated. Such is certainly one of the key results of the panels.

38744 **Solar-cell-efficiency measurements.** Emery, K.A.; Osterwald, C.R. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **17**: No. 2/3, 253-274(Apr-May 1986).

The calibration and efficiency-measurement procedures followed by the PV Devices and Measurements Branch at the Solar Energy Research Institute (SERI) are presented. The use of spectral-irradiance measurements to calibrate reference cells used in these measurements has reduced the uncertainty in the calibration number to less than 1%. The use of the spectral mismatch index can reduce the errors in short-circuit current measurements to about 2% for a wide variety of test-cell/reference-cell combinations and reduce the need for a close match between the test-cell and reference-cell spectral responses or the source spectrum and standard spectrum. The effect of various spectra in use by the PV community on the short-circuit current is presented for a variety of cell spectral responses.

38745 **Physical properties and photovoltaic potential of thin film of $CuGaSe_2$.** Noufi, R.; Powell, R.; Herrington, C.; Coutts, T. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **17**: No. 2/3, 303-307(Apr-May 1986). Contract AC02-83CH10093.

The opto-electronic properties and x-ray diffraction patterns of $CuGaSe_2$ thin films of various compositions were studied. The tetragonal phase was obtained at substrate temperature of 450°C. Films with resistivities in the range 10^{-1}-10^{6} Ω cm, and optical bandgap of 1.66-1.69 eV were attainable by varying the composition through control of the evaporation rates of the elements. An all-thin-film CDS/$CuGaSe_2$ (1 cm^2) solar cell was fabricated to demonstrate the photovoltaic potential of $CuGaSe_2$ thin films.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 38725, 38783

38746 **(SAND—86-7036-Vol.2) Modular array field designs for tracking flat-plate photovoltaic systems: Volume 2, Appendix.** Castle, J.A. (Hughes Aircraft Co., Long Beach, CA (USA)). Jun 1987. Contract AC04-76DP00789. 276p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87012022.

This report addresses the optimization of utility-sized, tracking flat-plate photovoltaic power systems. Structures optimized were one single-axis and one dual-axis tracking system using currently available system designs as baseline engineering reference points. Passive thermal-hydraulic tracking drive systems were evaluated and Freon-hydraulic units were found to be cost-effective in single-axis tracking. Building-block configurations ranging in size from 35 kW to 5 MW were established using the optimized single- and dual-axis tracking structures, and their reliability and availabil-

ity were analyzed. A 1-MW single-axis building block design was selected to develop engineering plans for a 100-MW PV power plant designed to operate unattended. Eleven-percent efficient PV panels at $220/m² were used in the study, and single-axis, flat-plate tracking systems were found to be significantly more cost-effective than dual-axis systems. A prototype tracking array was built and tested at Sandia, where cost and performance data supported lower economic projections for large PV tracking arrays.

38747 **(SAND—87-1124C) The issue of harmonic injection from utility integrated photovoltaic systems: Part 2, Study results.** Stevens, J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870757—3). NTIS, PC A02. File Number DE87011635.

From IEEE Power Engineering Society summer meeting; San Francisco, CA, USA (12 Jul 1987).

Harmonic injection is a growing concern to electric utility companies. One potential source of harmonics is utility intertied photovoltaic (PV) systems. This paper summarizes the results of several research efforts investigating harmonics injected by PV systems. These efforts indicate that harmonic injection from photovoltaic systems, while it can't be ignored, is no more a problem than the harmonic injection from several commonly used household appliances.

38748 **Operational experience with photovoltaic systems at the Florida Solar Energy Center.** Atmaram, G.H. (Florida Solar Energy Center, Cape Canaveral, FL 32920). pp 263-286 of Progress in solar engineering. Goswami, D.Y. New York, NY; Hemisphere Publishing (1985). (CONF-850858—).

From US/India binational symposium on solar energy research and applications; Roorkee, India (5 Aug 1985).

This paper describes the design and operational experience with photovoltaic systems at Florida Solar Energy Center. An attempt has been made to focus on the subject matter relevant to Indian research and application needs. The photovoltaic systems covered include stand-alone, grid-connected residential and grid-connected tracking systems. Based on the experience, some recommendations are made for the implementation of photovoltaic systems research and applications in India.

1407 Solar Thermal Power Systems

38749 **(CONF-870804—15) Reliability study of Stirling engines for solar dish/heat engine systems.** Holtz, R.E.; Uherka, K.L. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87011387.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The objective of this study was to examine the reliability of existing and improved Stirling engine concepts for dispersed solar dish-electric applications in the 25-50 kWe range. Five current kinematic Stirling engine designs have the capability to meet or exceed the 32% efficiency goal of the DOE Solar Thermal Program. A review of historical Stirling engine data illustrated that the three major reliability issues with kinematic Stirling engines are the piston-rod seals, engine hot parts (i.e., heater head, regenerator and cylinders) and power control/drive system. The most significant reliability issue associated with achieving the 50,000 hour operating life goal involves piston-rod seals. A specific kinematic engine concept that appears to have the potential for meeting the 50,000 hour operating lifetime requirement of solar power systems is the STM4-120 engine. This engine has a pressurized crankcase to reduce piston-rod seal problems, an indirect heat pipe hot-end section to smooth out temperature gradients in the heater tubes, and a variable angle swashplate for power control.

38750 **(ILR-MITT—168) Preliminary analysis of a prototype space solar power system.** Johenning, B.; Koelle, H.H. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt). 15 Oct 1986. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770163.

This report summarizes the results of a study project which was carried out at the Aerospace Department of the Technical University Berlin during the summer semester of 1986. The power unit under study was sized at a power level of 500 MW. The analysis concentrated on the assembly process to be carried out in the geostationary orbit. The satellite power unit proper and the infrastructure required (manufacturing plant, habitat, space port, space tugs etc.) has a total mass of close to 10 000 metric tons. These have to be transported to the assembly site from the earth surface. It is estimated that the assembly of this GEO complex will take approximately 40 months and at the average a crew of 40 at the assembly site. 134 flights of a space freighter with a payload of 100 metric tons each and 29 passenger flights are required to provide the logistics support. The transition from prototype assembly to large scale manufacturing is shortly discussed.

38751 **(PNL-SA—14030) Cost drivers for solar thermal central receiver power plants.** Brown, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 12p. (CONF-870307—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011992.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

System cost, when combined with performance and financing, determines the overall economic feasibility of a solar thermal central receiver system or any other energy system. The purpose of this paper is to present information that will allow preliminary evaluation of initial capital and annual operation and maintenance (O and M) costs for solar thermal central receiver systems. Cost estimating equations are presented for the principal solar thermal components. These equations are a function of one or two design variables and allow one to estimate the cost of a component over a broad range of the controlling design variable.

38752 **(SAND—86-1959C) Analysis of steam injected gas turbines for solar thermal applications.** Linker, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870804—3-Draft). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009846.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The Department of Energy's (DOE) Solar Thermal Program has as one of its program elements the development and evaluation of heat engine technologies which are applicable to Distributed Receiver Systems. The primary research and development activities, for the past several years, have involved the so-called dish-electric concept in which a heat engine, solar receiver, and generator are combined as a Power Conversion Assembly (PCA) and mounted at the focus of a parabolic dish concentrator. PCA's based on Rankine, Brayton, and Stirling cycle heat engines have been designed and built at 10 to 25 kWe power levels with varying degrees of success. The small Brayton cycle engines in particular have fallen short of expectations as a focal mounted PCA. This report will analyze larger Brayton engines (500 kWe and above) supplied with fossil energy and solar energy from an array of 15 m diameter parabolic dishes or small central receivers. In particular, a stress injected gas turbine (STIG) cycle will be examined because of its ability to offer high efficiencies. This report outlines quantitatively the cycle parameters which effect efficiency for a solar augmented steam injected gas turbine.

38753 **(SAND—87-0131) Proceedings of the concentrating solar collector workshop: Key technical issues.** Leonard, J.A.; Diver, R.B.; Mancini, T.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012315.

This report comprises the proceedings of a solar thermal workshop on the key technical issues involved in the research and development of concentrating solar collectors. The workshop was held at Sandia National Laboratories on October 7 and 8, 1986. The major topic areas were solar concentrator optics, soiling of optical surfaces, windloads on collectors, and solar receiver issues.

38754 **Energetics of extended operation of a hybrid solar total energy system.** Stine, W.B.; Heckes, A.A. (California State Polytechnic Univ., Pomona, CA). pp 793-801 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The U.S. DOE sponsored Solar Total Energy Project (STEP) at Shenandoah, Georgia, provides electricity, process team, and cooling to the adjacent Bleyle of America knitwear facility. In the summer of 1985 a set of continuous operations experiments were performed where the STEP plant was operated, during the daytime only, for 30 consecutive days, and continuously (24 hours per day) for a period of 14 consecutive days. The operational mode was cogeneration energy output, with hybrid (solar/fossil) energy input. Solar energy was utilized as much as possible. This paper presents results from these experiments.

1408 Ocean Energy Systems

38755 **(CONF-8705145—1) Experimental investigation of marine biofouling and corrosion for tropical seawater.** Panchal, C.B. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011427.

From Advances in fouling science and technology; Braga, Portugal (19 May 1987).

Biofouling and corrosion for marine heat exchangers are being investigated at the Natural Energy Laboratory of Hawaii. The objective of this experimental investigation is to determine effective fouling-control techniques for ocean thermal energy conversion (OTEC) heat exchangers, which must be kept clean enough to maintain heat-transfer resistance (R/sub f/) values below 0.02 m^2K/kW. Due to the lack of experimental data bases and prediction methods, fouling-control techniques developed for conventional heat exchangers cannot easily be extended to OTEC applications. In addition, it is important to develop low-cost heat exchangers that will use less-expensive materials. Therefore, a long-term experimental program was initiated during an early stage of the project. After conducting preliminary experiments in the Gulf of Mexico on a floating platform (1) and in Hawaii with a submerged buoy (2), a permanent test facility was built on the island of Hawaii. Over several years of continuous testing, many series of experiments were carried out to develop a technical data base for biofouling and corrosion of candidate materials. In this paper, the experimental investigation is summarized, and observed data are discussed.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 39141

38756 **(EUR—9954) Solar modular house.** Fonzi, F.; Cassio, G.; Herzog, T. (Commission of the European Communities, Luxembourg). 1985. 42p. (In German, English and Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752646.

The present report describes a project already developed with European Community Funding. The work has been carried out between spring 1983 and summer 1984. The major goal was to design and build a structure suitable for Mediterranean countries and more precisely a kind of house whose characteristics are illustrated with details hereafter. The report contains essentially the results in relation to the fundamental objectives and to the work schedules. No mention is made of the evolutions of the project or of the extras initiated but not completed. The house-testing has yet to be done. A search for industrial mass production has not yet been carried out. Nevertheless, the prototype costs are inferior to the average statistical figures of houses of equal size built with the traditional methods here in Italy.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 38734, 38749, 38753

38757 **(IEA-SHAC-TVI—3-Summ.) Characterization of evacuated collectors, arrays and collection subsystems: Summary.** Guisan, O.; Lachal, B.; Mermoud, A.; Rudaz, O. (Geneva Univ. (Switzerland); International Energy Agency, 75 - Paris (France)). Jun 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900817.

After six years of detailed investigations at twelve installations by the ten countries of the International Energy Agency Task on Evacuated Collector Systems, we present a summary of the main characteristics of evacuated collectors and associated components, as they were carefully identified, defined and evaluated.

38758 **(TVA/OP/EDT—87/27) Final report of the study on UTC [University of Tennessee at Chattanooga] operation of the TVA nonconvecting Solar Pond as an Energy Engineering Field Laboratory.** Cunningham, J.R.; Chopra, P.; Hiestand, J.W.; Damshala, P.; Eldridge, T. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology; Tennessee Univ., Chattanooga (USA)). 8 Apr 1987. 61p. NTIS, PC A04/MF A01. File Number DE87900850.

The University of Tennessee at Chattanooga (UTC) has reviewed the background and operation of the Tennessee Valley Authority (TVA) solar pond facility and investigated the possibility of operating the pond while utilizing it as a energy field engineering laboratory. Possible sources of financial support for UTC's operation of the facility have been examined. UTC has determined that it is both feasible and desirable for the School of Engineering to utilize this facility as an educational resource. During the brief period of this study, it was not possible to obtain commitments for external funding. It is recommended that UTC operate the solar pond as an educational facility for the next six months with limited financial support from TVA. During this six months period, it is recommended that UTC and TVA personnel work closely together to secure long term commitments for funding the facility and to examine alternative plans for the facility including phased decommissioning.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

38759 (INIS-mf—10632, pp 59) **Project 'Geothermal Atlas of Europe'.** Hurtig, E. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38760 **Magma energy.** Hardee, H.C. (Geophysics Div. 1541, Sandia National Labs., Albuquerque, NM 87185). pp 275-280 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Evidence accumulated over the past ten years has established that it is scientifically feasible to extract energy from extensive sources of shallow molten magma deposits in the Earth's crust. The USGS estimates the amount of the magma resource in the upper 10 km of the crust in the western continental United States to be of a quantity equal to 5 x 10/sup 23/ J or about 7000 times the annual United States total energy consumption. The worldwide magma resource is estimated to be 1.5 x 10/sup 25/ J. Recent studies indicate that the magma resource in the crust is replenished or renewed at a significant rate. Theoretical studies, and laboratory and field experiments have led to the conclusion that it is scientifi-

cally feasible to drill into a magma body and extract useful heat. Field experiments conduced at volcanic eruption sites and in lava lakes have examined the geophysical state of molten rock, methods of drilling molten rock and heat extraction techniques. The Magma Energy Program has recently moved into the engineering feasibility stage. This program, sponsored by the Geothermal Technology Division of The Department of Energy, will investigate the development of techniques and hardware necessary to build a magma energy plant. Within the next few years a hole will be drilled into a shallow body in the western United States for the purpose of evaluating the engineering feasibility of magma energy. Target sites for the first magma energy well are at Long Valley, CA. and Cosco, CA.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 39719, 39720

38761 **(DOE/ER/13467—T1) Hydrothermal brecciation in the Jemez Fault zone, Valles Caldera, New Mexico: Results from CSDP [Continental Scientific Drilling Program] corehole VC-1.** Hulen, J.B.; Nielson, D.L. (Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.). Jun 1987. Contract FG02-86ER13467. 74p. (ESL—87005-JP). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012101.

Paleozoic and Precambrian rocks intersected deep in Continental Scientific Drilling Program corehole VC-1, adjacent to the late Cenozoic Valles caldera complex, have been disrupted to form a spectacular breccia sequence. The breccias are of both tectonic and hydrothermal origin, and probably formed in the Jemez fault zone, a major regional structure with only normal displacement since mid-Miocene. Tectonic breccias are contorted, crushed, sheared, and granulated; slickensides are commmon. Hydrothermal breccias, by contrast, lack these frictional textures, but arej commonly characterized by fluidized matrix foliation and prominent clast rounding. Fluid inclusions in the hydrothermal breccias are dominantly two-phase, liquid-rich at room temperature, principally secondary, and form two distinctly different compositional groups. Older inclusions, unrelated to brecciation, are highly saline and homogenize to the liquid phase in the temperature range 189 to 246°C. Younger inclusions, in part of interbreccia origin, are low-salinity and homogenize (also to liquid) in the range 230 to 283°C. Vapor-rich inclusions locally trapped along with these dilute liquid-rich inclusions document periodic boiling. These fluid-inclusion data, together with alteration assemblages and textures as well as the local geologic history, have been combined to model hydrothermal brecciation at the VC-1 site.

38762 **(EUR—9332) Application of a computer model to the study of the geothermic field of Mofete, Italy.** Giannone, G.; Turriani, C.; Pistellie, E. (Commission of the European Communities, Luxembourg). 1984. 291p. (In Italian). Commission of the European Communities, Luxembourg.

The aim of the study was to develop a reliable and comprehensive reservoir simulation package for a better understanding of "in-situ" processes pertinent to geothermal reservoir hydrodynamics and thermodynamics, and to enable an assessment of optimum reservoir management strategies as to production and reinjection policies. The study consists of four parts: The first deals with the computer programme. This is based on a programme called "CHARG"developed in the US. Some adaptation was necessary. The second part concerns the fall-off and pit-tests of the geothermal well close to Naples "Mofete 2". This has been a crucial test for the CHARG model using asymmetric cylindrical coordinates and 14 different layers. Part three deals with predictions about longevity of the geothermal field of Mofete. The area is divided into 2500 blocs distibuted over 14 layers. Several configurations (various numbers of production and reinjection wells) have been tested. The last chapter delas with a comparison between the ISMES reservoir model, based on the finite elements approach and the AGIP model (finite differences). Both models give nearly the same results when applied to the geothermal field of Travale.

38763 (INIS-mf—10632, pp 48) **Depth dependence of heat production in the continental lithosphere.** Rybach, L.; Cermak, V. (Eidgenoessische Technische Hochschule, Zurich, Switzerland. Inst. fuer Geophysik; Ceskoslovenska Akademie Ved, Prague. Geofyzikalni Ustav). 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38764 (INIS-mf—10632, pp 56) **New evidences for intracrustal magma bodies beneath the Urach volcanic area/SW-Germany.** Sachs, P.M. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 39728

38765 (INIS-mf—10632, pp 136) **Teleseismic investigation of the velocity structure beneath the geothermal area of Urach, Southern Germany.** Achauer, U. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38766 (INIS-mf—10632, pp 187) **Opportunities for thermal research with deep scientific holes in the Appalachian Orogen and other continental terranes.** Decker, E.R.; Costain, J.K. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38767 (INIS-mf—10632, pp 233) **Geothermal exploration of the location Oberpfalz in the framework of the continental deep well drilling program (KTB).** Burkhardt, H.; Grimmeisen, W.; Honarmand, H.; Waegerle, P. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38768 (INIS-mf—10632, pp 234) **Geothermal KTB exploration in the middle Black Forest.** Stiefel, A.; Finkbeiner, K.; Wilhelm, H. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38769 **(UCRL—96509) Seismic imaging of the Medicine Lake Caldera.** Zucca, J.J.; Evans, J.R.; Kasameyer, P.W. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 6p. (CONF-8704110—11). NTIS, PC A02. File Number DE87011567.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

Medicine Lake Volcano, a broad shield volcano about 50 km east of Mount Shasta in northern California, produced rhylotic eruptions as recently as 400 years ago. Because of this recent activity it is of considerable interest to producers of geothermal energy. The USGS and LLNL conducted an active seismic experiment designed to explore the area beneath and around the caldera. This experiment had two purposes: To produce high-quality velocity and attenuation images of the young magma body presumed to be the source for the young volcanic features, and to collect a dataset that can be used to develop and test seismic imaging methods that may be useful for understanding other geothermal systems. Eight large explosions were detonated in a 50 km radius circle around the volcano, a distance chosen to produce strong upward traveling signals through the area of interest. The data were inverted using Aki's method to produce three-dimensional velocity and attenuation images of the sub-surface. Preliminary interpretation shows low velocity and attenuation on the flanks of the volcano, and coincident high attenuation values and low velocities (-20%) from 3 to 5 km beneath the center of the caldera. This zone may be a region of partial melt which fed the youngest eruptions.

38770 **(UCRL—96511) Geophysical monitoring of injected fluids.** Kasameyer, P.W. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 4p. (CONF-8704110—12). NTIS, PC A02. File Number DE87011568.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

During injection, a pressure front, fluid front, and thermal front are formed, and move away from the injection well. The performance of a geothermal field is determined by the movement of these fronts through it. The Brine Injection Technology Program is developing modeling and measurement techniques to help industry determine where these fronts are and to predict their evolution. Because these fronts change the physical properties of the reservoir medium as they pass, Lawrence Livermore National Laboratory is studying the application of geophysical methods to provide information about the location of fronts away from observation and sampling wells. The ultimate purpose is to model the behavior of the field and predict its performance. In FY86, we concentrated on collecting microseismicity and electrical self potential data before and after the start-up of a moderate sized geothermal plant. In FY 87, we will complete the analysis of these data sets, and continue collecting case history information.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 38760

38771 **(EPRI-AP—5310) Statistical analysis of geothermal wells in the United States: Final report.** Henneberger, R.C.; Sanyal, S.K. (GeothermEx, Inc., Richmond, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920524.

This report presents a summary of the flow characteristics of geothermal wells in the United States. A data base consisting of measured flow rates, wellhead pressures, wellhead temperatures and fluid enthalpies for more than 500 wells has been compiled to provide the statistical basis for the summary. Three classes of wells are considered separately: dry steam, flowing hot water, and pumped hot water. The distributions and relationships of the 4 well parameters are shown in a series of histograms and crossplots for the different well classes. The methodology used to compile the well data and to compute the statistics is described and potential sources of error and bias in the data base are discussed.

38772 **Present status of hot dry rock technology.** Nunz, G.J.; Franke, P.R. (Los Alamos National Lab., Los Alamos, NM 87545). pp 235-240 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

The primary objective of the HDR program is to develop and demonstrate the technology required for commercial purposes. However, its ultimate goal is to transfer this technology to the private sector at a level of maturity and economic promise that will enable industry to proceed with the further development and broad application of HDR energy systems. Toward this end, technology transfer has been, and continues to be an essential element in the Program. It has occurred in the form of complementary programs, presentations and publications, and the development of equipment, instruments, techniques and analyses. Technology transfer also occurred with field support of other geothermal programs as, for example in Central America. While commercial production of energy from the "inexhaustible" hot dry rock energy resource is still in the future, an aggressive program of technology transfer is hastening the time when that may occur.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 38761

38773 **(EUR—10176) Rock-water interaction in hot dry rock geothermal systems.** Althaus, E.; Gijbels, R. (Commission of the European Communities, Luxembourg). 1985. 61p. NTIS (US Sales Only), PC A04. File Number DE87752650.

Minerals likely to be components of HDR geothermal energy recovery systems were investigated experimentally with respect to their reactions with hydrous heat exchange media. It was shown that both mafic (enstatite, aegirine-augite, hornblende) and salic (lepidolite mica, albite) minerals react with aqueous fluids according to a simple scheme in which H/sup +/ ions are exchanged by metal cations. Acidity and liquid composition were found to be the most important factors influencing degree and rate of reaction. Extraction of components from solids usually occurs in an incongruent way. The original surfaces are changed either by selective leaching or by deposition of secondary phases. Trace element determinations confirm this conclusion. The layers formed by these processes are inhibitory to further reactions. Thermodynamically unstable minerals have higher reaction rates than more stable ones. In rocks the mixtures of minerals react according to different mechanisms. The decomposition rates of less quickly leached phases are depressed by the constituents delivered by fastly reacting minerals. By these processes the behaviour of HDR systems is determined. Leaching rates and decomposition mechanisms can be changed at will by adjusting fluid compositions to the processes wanted.

38774 (INIS-mf—10632, pp 63) **Permeability of Urach core samples under confining pressure.** Huenges, E.; Will, G. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38775 (INIS-mf—10632, pp 64) **Complex resistivity of rocks from deep drillings.** Nover, G.; Will, G. 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

38776 (INIS-mf—10632, pp 211) **Three-dimensional calculations for hydrothermal heat transfer in porous media.** Clauser, C. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

17 WIND ENERGY

1701 Availability (climatology)

38777 **(BMFT-FB-T—86-175) Air flow on hills from models and experiments. Final report.** Hoff, A.M.; Tetzlaff, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Hannover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie). Dec 1986. 252p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87770243.

An international experiment was conducted to evaluate the structure of the boundary-layer over a nearly two-dimensional hill with a crest height of about 110 m. The results comprise data on the mean wind flow as well as the characteristic changes in turbulence. Comparisons with theoretical models show that the depth of the friction layer on the hill was generally overestimated. For further progres in the quantification of the wind field on a hill further more detailed information is still necessary. With 20 refs., 1 tab., 13 figs.

1706 Wind Energy Engineering

38778 **(DOE/CE/15279—T4) Build, install and demonstrate a variable stroke pump control and windmill system: Fourth quarterly technical progress report.** Avery, D.E. (AV-YO, Inc., Kaneohe, HI (USA)). 1987. Contract FG01-86CE15279. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011278.

The Variable Stroke Mechanism (VSM) and the New Gear Drive (NGD) are ready for installation and testing. Photos and many detail drawings have been made for the VSM and the NGD. A sample of these drawings is included in this report.

38779 **(ETSU-WN—5022A) Aeroelastic analysis facilities for UK wind turbines. Main report.** McIver, D.B.; Wooton, L.R. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Apr 1984. 161p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The results of a study to assess the suitability of existing wind turbine aeroelastic computer programs for a long-term commitment of the UK to wind turbine design are presented. The assessment of the programs has been made on the basis of how they compare with modern software engineering practice; the perceived future requirements of wind turbine design; the validity of their theoretical bases and their available facilities. It is concluded that there does not yet appear to be a definitive mathematical formulation of the wind turbine aeroelastic problem.

38780 **(ETSU-WN—5043/1) Aerodynamic research requirements for fixed pitch horizontal-axis wind turbines. Final report.** Hales, R.L. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). [1987]. 66p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The aerodynamic requirements to support the design of large, stall-regulated horizontal-axis wind turbines (HAWTs) are reviewed. This is done by an analysis of some 150 items from the published literature, covering the development of stall boundary layer prediction methods and HAWT performance prediction methods. Finally, recommendations are made for further aerodynamic research on the stalling behaviour of the fixed pitch rotor.

38781 **(SAND—86-7182) User's manual for ADAM (Advanced Dynamic Airfoil Model).** Oler, J.W.; Strickland, J.H.; Im, B.J. (Texas Tech Univ., Lubbock (USA). Dept. of Mechanical Engineering; Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012342.

The computer code for an advanced dynamic airfoil model (ADAM) is described. The code is capable of calculating steady or unsteady flow over two-dimensional airfoils with allowances for boundary layer separation. Specific types of airfoil motions currently installed are steady rectilinear motion, impulsively started rectilinear motion, constant rate pitching, sinusoidal pitch oscillations, sinusoidal lateral plunging, and simulated Darrieus turbine motion. Other types of airfoil motion may be analyzed through simple modifications of a single subroutine. The code has a built-in capability to generate the geometric parameters for a cylinder, the NACA four-digit series of airfoils, and a NASA NLF-0416 laminar airfoil. Other types of airfoils are easily incorporated. The code ADAM is currently in a state of development. It is theoretically consistent and complete. However, further work is needed on the numerical implementation of the method.

38782 **(SAND—86-7183) A numerical model for unsteady two-dimensional flow calculations with flow separation.** Oler, J.W.; Strickland, J.H.; Im, B.J. (Texas Tech Univ., Lubbock (USA). Dept. of Mechanical Engineering). Jun 1987. Contract AC04-76DP00789. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012316.

A numerical model for two-dimensional airfoils in unsteady motion with boundary layer separation is described. The airfoil and wake surfaces are represented by a finite set of combined source and vortex panels. The source strengths are prescribed to have the same magnitude as the normal relative velocity on the surface due to the freestream and motion of the airfoil. The vortex strengths on the airfoil surface are determined by applying a kinematic surface tangency condition to a Green's function representation of the potential field while simultaneously enforcing the Kutta condition. Wake shedding is governed by a dynamic free surface condition and the characteristics of the flow near any boundary layer separation points. Wake deformation is predicted by applying a geometric free surface condition. Calculation results are presented for steady motion, impulsively started rectilinear motion, harmonic pitch oscillations, and constant pitching motions. Experimental data and analytical solutions are also presented for comparison.

38783 **(SERI/SP—217-2950) Multisource energy system project.** Dawson, R.W.; Cowan, R.A. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1987. Contract AC02-83CH10093. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001150.

The mission of this project is to investigate methods of providing uninterruptible power to Army communications and navigational facilities, many of which have limited access or are located in rugged terrain. Two alternatives are currently available for deploying terrestrial stand-alone power systems: (1) conventional electric systems powered by diesel fuel, propane, or natural gas, and (2) alternative power systems using renewable energy sources such as solar photovoltaics (PV) or wind turbines (WT). The increased cost of fuels for conventional systems and the high cost of energy storage for single-source renewable energy systems have created interest in the hybrid or multisource energy system. This report will provide a summary of the first and second interim reports, final test results, and a user's guide for software that will assist in applying and designing multi-source energy systems.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 38499, 38500, 38689, 38690, 39157, 39193, 39427

38784 **(DFVLR-FB—87-02) Theoretical investigations of three turbine cascades using a 2-D time marching procedure.** Giess, P.A. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 1987. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770167.

For subsonic and transonic downstream velocities extensive flow field calculations have been done for one stator and two rotor cascades using a 2-D time marching procedure. Convergency of the numerical solution has been investigated with respect to the homogeneous flow. The local flow quantities have been evaluated to

check some of the assumptions related to simplified methods for calculating the homogeneous downstream flow angle. The calculated results have been compared with experimental data. With 36 figs., 8 tabs., 12 refs.

38785 **(DOE/MC/23167—2277) Advanced Coal-Fueled Gas Turbine Systems: Semiannual report for the period July-December 1986.** (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Operations). Jan 1987. Contract AC21-86MC23167. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001066.

During this period, effort has concentrated on three tasks: Reference System Definition, Test Fuel Specification, and Subscale Combustion System. This is the first semiannual technical progress for the program.

38786 **(EPRI-CS—5271) Guidelines on macrofouling control technology: Final report.** (Stone and Webster Engineering Corp., Boston, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 254p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920486.

Condenser macrofouling is a major source of problems causing poor power plant availability and efficiency. This report presents the evaluation of antifouling coatings (toxic and nontoxic) and mechanical controls (screens and filters), together with recommended practices for intake screening and debris filters. Seven toxic coatings, applied on steel and concrete surfaces, were tested and evaluated at 19 generating stations located on the Pacific, Gulf, and Atlantic coasts over a 3-year period from 1983 to 1986. These coatings are ranked as to their performance. In addition, two nontoxic coatings of the low surface energy type were tested and evaluated. Traveling screen modifications designed to reduce or eliminate carry-over and to handle fish and heavy influxes of debris were evaluated at 13 generating stations located on the Pacific, Gulf, and Atlantic coasts, Puerto Rico, the Great Lakes, and on various rivers. These include through-flow, dual-flow, and angled-screen arrangements. Modifications include materials, variable speed drive control systems, upgrading of mechanical features for continuous operation, various screen meshes, fish buckets, dual-spray systems, debris scrapers, and various anticlogging features for the screen-wash systems. Debris filters that supplement intake screening were evaluated at 10 generating stations located on the Pacific and Gulf coasts, and on various rivers. Three commercially available types most commonly used in the US and three "home made" designs were evaluated. Antifouling coatings and mechanical controls proved to be effective as macrofouling control measures. The acrylic-tributyltin polymer coating with cuprous oxide cotoxicant and rosinated vinyl with cuprous oxide toxicant were most effective. Recommended practices (guidelines) for intake screening and debris filters are discussed in detail.

38787 **(EPRI-CS/EL—5251-SR) Proceedings: 1986 power plant performance monitoring and system dispatch conference.** Diaz-Tous, I.A.; Lansing, N.F. (eds.). (Encor-America, Inc., Los Altos, CA; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 522p. (CONF-8611176—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920514.

From Power plant performance monitoring and system dispatch conference; Washington, DC, USA (12 Nov 1986).

This EPRI-sponsored workshop was organized to address performance monitoring and system dispatch improvements, primarily those being developed by EPRI projects RP1681 and RP2153. Formal presentations emphasized the state-of-the-art performance monitoring and instrumentation system being developed for Morgantown Unit 2, the host unit for this joint project, and the associated advances in algorithms and communications being developed to improve system dispatch. There were also several presentations on utility experiences with performance monitoring and dispatch. The five sessions of formal presentations were: General, utility experience, turbines and auxiliaries, electrical systems dispatch, and boilers and auxiliaries. Four discussion groups on related topics enabled workshop participants to exchange ideas and information, and also contributed suggestions to EPRI for R & D needs. Papers have been entered individually into EDB and ERA.

38788 **(EPRI-EM—5256-SR) Proceedings: Heat exchanger workshop.** (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 56p. (CONF-8606320—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920491.

From Heat exchanger workshop; Palo Alto, CA, USA (10 Jun 1986).

Heat transfer processes are of controlling importance in the operation of a thermal power plant. Heat exchangers are major cost items and are an important source of problems causing poor power plant availability and performance. A workshop to examine the improvements that can be made to heat exchangers was sponsored by the Electric Power Research Institute (EPRI) on June 10-11, 1986, in Palo Alto, California. This workshop was attended by 25 engineers and scientists representing EPRI-member utilities and EPRI consultants. A forum was provided for discussions related to the design, operation and maintenance of utility heat transfer equipment. The specific objectives were to identify research directions that could significantly improve heat exchanger performance, reliability and life cycle economics. Since there is a great diversity of utility heat transfer equipment in use, this workshop addressed two equipment categories: Boiler Feedwater Heaters (FWH) and Heat Recovery Steam Generators (HRSG). The workshop was divided into the following panel sessions: functional design, mechanical design, operation, suggested research topics, and prioritization. Each panel session began with short presentations by experts on the subject and followed by discussions by the attendees. This report documents the proceedings of the workshop and contains recommendations of potentially valuable areas of research and development. 4 figs.

38789 **(NP—7752236) SFB 211, University of Hannover. Annual report 1983/1984.** (Hannover Univ. (Germany, F.R.). Sonderforschungsbereich 211 - Zeitabhaengige Vorgaenge und Schadenserkennung in Komponenten Waermetechnischer Anlagen). Sep 1984. 142p. (In German). NTIS (US Sales Only), PC A07. File Number DE87752236.

This contribution describes research from the area of time-dependent processes and recognising damage in components of thermal plants for the economically optimum design, for safe operation, for effective supervision and for avoiding serious damage to components. Some work belonging to one of the three following project areas is introduced: - Project area A: Time-dependent processes in heat exchanger equipment and pipelines. - Project area B: Non-steady flow and structure mechanics behaviour of turbines. - Project area C: Analytical methods for recognising damage in plants and components. (HAG).

38790 **(STEV—1986-R12) Fresh production of electric power when accelerating nuclear power phaseout PFBC. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751954.

The alternative PFBC = Pressurized Fluidized Bed Combustion has been studied. The plant would function without external NOsub(x) purification. The cost excluding fuel is estimated to be 0.14 to 0.17 SEK per kWh and the investment to SEK 6 400 to 7 400 per kW. Purification of NOsub(X) would require additional SEK 260 per kW.

38791 **(STEV—1986-R13) Gasification of indigenous fuels for electric power production at combined power and heating plants. After Chernobyl.** Fors, J.; Magnusson, L. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751955.

It is shown that it is possible to develop gasification technique and commercialize it. The price of electric power is estimated to be below the cost of a coal fired steam turbine. The total capacity could amount to 10-15 TWhsub(el) with heat delivery to district heating and industry. Large plants can be designed by parallel connection of aggregates. In order to introduce the technique, some 3 to 5 years are needed for the development.

38792 **(STEV—1986-R14) Means of supply of extremely low-sulphur oil to the power plants of Stenungsund and Karlshamn. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751956.

The power plants in question are estimated to produce 10 TWh electric power per year and use about 2.4 Mtons of heavy fuel oil. This will imply a considerable increase of emission of acidifying sulphur oxides. The report discusses the cost of supplying low-sulphur fuel oils. The cost is compared with the cost of the installation of desulphurization of flue gas, oils or gasification.

38793 **(STEV—1986-R17) Effect of a phase out of nuclear power in OECD countries on demand for fossil fuel and on sulfur precipitation in Sweden. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 104p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751959.

This report has been prepared to evaluate the effect of a phase out of nuclear generating capacity in OECD countries on the demand for, and price of, coal and oil in 1990 and 1995, and to assess the effect of increased use of fossil fuels on pollution from sulfur precipitation in Sweden. Our forecasts are based on the model which is shown diagrammatically. We begin with overall energy demand and in particular with forecasts of electricity demand in the key OECD countries. Demand is related to existing capacity and to current plans to install new capacity. The fuel demand resulting from these present plans has been calculated - this provides the base case. Existing and planned non-nuclear capacity is then related to demand and the nuclear capacity which must be retained in 1990 and the new non nuclear capacity which must be constructed for 1995 has been estimated. Fuel demand under these new conditions has then been computed and the increase resulting from a nuclear phase out has been calculated. The effect of this increase has been related to overall world demand for fuels and the effect on prices has been predicted. The emission, transport and precipitation of sulfur in Sweden and its neighbours has been considered. The increase in precipitation which will occur as a result of this greater use of fossil fuels has been calculated.

38794 **(STEV—1986-R20) Industry's use of electric power. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden); Aaf, Energikonsult, Stockholm (Sweden)). Oct 1986. 260p. (In Swedish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87751962.

Alternative energy supplies and adaptation to energy demand are elucidated, primarily concerning space heating and industry. The consequences of the alternatives on the economic development of Sweden, the growth of industry, the situation of households and the effects of health and environment are being analysed. It is concluded that considerable portions of the industry will loose their competitive advantages. There will be restricted possibilities to solve the technical adaptation to the year 1997.

38795 **(STEV—1986-R21) Analysis of forestry region when changing energy prices. After Chernobyl.** Loenner, G.; Nilsson, S.; Nordvall, H.O. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751963.

Altered energy prices will reflect a possible nuclear power phaseout. The aim has been to elucidate the situation of the year 2000. The so called world bank model has been used. The forecasting is summarized and commented upon. The results are considering cutting, sawmills, board industry, pulp and paper industry and the social consequences.

38796 **(STEV—1986-R22) New production of electric power when accelerating nuclear power phaseout. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden); Aaf, Energikonsult, Stockholm (Sweden)). Oct 1986. 153p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751964.

This investigation states that it is possible to eliminate nuclear power to the beginning of the year 2000. In this case the time for planning and construction of large coal power plants with condenser turbines should be set at seven years. The production cost excluding fuel will be 0.12 to 0.19 SEK per kWh. Investment cost is estimated to 5,500 to 8,200 SEK per kW. When using wood chips the cost will be 0.30 SEK and 11,300 SEK, respectively. A large part of the increased cost will include substantial flue gas purification. The existing plant of Karlshamn should be maintained with a minimum of charges and extensions.

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REFER ALSO TO CITATION(S) 38498, 39572, 39574, 39625, 39648

38797 **(CONF-870659—3) Ceramic-fiber ceramic-matrix hot-gas filters.** Stinton, D.P.; Chang, R. (Oak Ridge National Lab., TN (USA); Acurex Corp., Mountain View, CA (USA)). Jun 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012538.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

This program is currently developing a process for the fabrication of ceramic composite filter specimens by chemical vapor deposition. A process for the fabrication of dense ceramic composites is being modified to produce low density filter specimens. The process modifications include elimination of the thermal gradient across the fibrous preform and the control of the porosity distribution to produce a composite suitable for high-temperature filter applications. The configuration of the filter specimens (fiber composition and porosity distribution, composition of deposited material, filter design, etc.) will be investigated to optimize filter efficiency, cleanability, strength, toughness, and chemical compatibility. Filter specimens of the optimum configuration will then be fabricated in tubular shapes for candle filter applications. Corrugated fabrics will be utilized to increase the available surface area of the candle filter. 5 refs., 7 figs.

38798 **(DOE/PC/81008—T8) Direct sorbent injection for combined SO_2/NO/sub x/ removal: Quarterly technical progress report, January-March 1987.** Dowdy, T.E.; Henry, J.M.; Holt, J.K.; Lee, J.J.; Smith, J.R. (Tennessee Univ., Tullahoma (USA). Space Inst.). 1987. Contract AC22-85PC81008. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012051.

Work on SO_2 only removal is nearing completion. Initial results are reported. Testing during the next quarter will concentrate on combined SO_2 and NO/sub x/ removal and in filling data gaps for SO_2 removal. This will include installation of an NO injection and control system. A sodium based additive will be used to achieve NO/sub x/ removal. The modeling effort will concentrate upon addition of reaction chemistry via a SPRAYMON type algorithm to the fluid mechanics. Work will continue on modeling water evaporation and droplet motion.

38799 **(EPRI-CS—5198-Vol.1) Electrostatic precipitator guidelines: Volume 1, Design specifications: Final report.** Altin, C.A.; Grieco, G.J. (Ebasco Services, Inc., Norcross, GA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 631p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920489.

The report includes three companion manuals for design specifications, operations and maintenance, and troubleshooting. Although the manuals primarily address users having some knowledge of precipitator design and operation, they provide enough background material and precipitator theory to make them useful as training aids. The loose-leaf format will allow updating.

38800 **(EPRI-CS—5281) Manual for management of low-volume wastes from fossil-fuel-fired power plants: Final report.** Holcombe, L.J.; Behrens, G.P.; Galegher, S.J.; Owen, M.L. (Radian Corp., Austin, TX (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 396p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920496.

Proper handling, treatment and disposal of power plant low volume wastes depend on the classification of these wastes as hazardous or nonhazardous according to prevailing environmental regulations. The objectives of this study were (1) to collect and char-

acterize according to Resource Conservation and Recovery Act (RCRA) procedures a series of low volume waste samples, and (2) to summarize the technical and economic aspects of suitable low volume waste treatment options. An evaluation of 90 samples from 21 plants indicated that boiler chemical cleaning wastes have the greatest potential for being classified as RCRA hazardous. Because low volume wastes are generated intermittently and have varied chemical compositions, an integrated approach to treatment and disposal is recommended. In many instances, codisposal of low volume wastes with high volume wastes is an effective and economic treatment approach. However, some wastes, such as boiler chemical cleaning wastes containing chelating agents, may require the use of dedicated treatment/disposal facilities.

38801 **(EPRI-CS—5288) FMC limestone double-alkali flue gas desulfurization process: Pilot plant testing: Final report.** Troupe, J.S.; Shepley, D.C. (Bechtel Group, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 236p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920516.

This report documents pilot plant testing of a 3 MW (9500 acfm equivalent flue gas flow) FMC limestone double alkali FGD process operating on a slipstream of a commercial 420 MW boiler burning 3.5% sulfur coal. The report discusses the rationale behind EPRI's decision to participate in the testing aspects of this project, the history of the development of limestone double alkali technology, and the chemistry involved in this technology's operation. The largest part of the report is devoted to the results obtained from tests conducted during 65 days of pilot plant operation. All of the major raw and reduced operating and analytical data taken during testing are reproduced in the appendices to the report, along with quality assurance information to support the validity of the data obtained. The report discusses the test results in detail and presents technical observations regarding their implications. The FMC limestone double alkali FGD process (1) can consistently remove 92 to 93% of SO_2 from high-sulfur coal flue gas, (2) can achieve high limestone utilization and low soda ash losses, (3) produces a manageable waste filter cake, (4) is highly tolerant of upsets in limestone feed, soda ash makeup, and regeneration residence time, and (5) presents no unusual safety or environmental problems. The process, like conventional limestone scrubbing, shows some adverse effects of increasing soluble magnesium concentration on solids quality and requires a finely ground limestone feed material to achieve high limestone utilization. However, neither limestone grind nor magnesium concentration appears to affect SO_2 removal efficiency. The report suggests specific lines of future developmental work and future demonstration testing to enhance the attractiveness of this process to the electric utility industry. A bibliography of limestone double alkali literature is included. 3 refs., 25 figs., 4 tabs.

38802 **(NP—7770159) Technical state of emission reduction: A summary for coal, oil and gas.** Fritsche, U. (Institut fuer Angewandte Oekologie, Darmstadt (Germany, F.R.)). Oct 1985. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770159.

The report examines the measures for reducing the emission of noxious substances from plants using coal, oil and gas. The legal requirements and regulations are used as the basis for assessing the measures. The reduction of SO/sub 2/, nitrogen oxide and halogens is discussed for the combustion of coal. The processes used for this are discussed and their effects on the environment are examined. A further main point is the reduction of dust, particularly from fluidized bed firing. The emission of hydrocarbons is examined, in addition, in the use of oil and gas. The emissions from burning rubbish are discussed. The global and indirect environmental effects of emission are explained and unsolved problems are mentioned. (HLN).

38803 **Emissions control through dry scrubbing.** Farber, P.S. New York, NY; American Institute of Chemical Engineers (1985). 25p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract W-31-109-ENG-38.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 15C.

Argonne has had a high-sulfur dry FGC system in operation for the last three years. The authors have successfully demonstrated that reliable, economical removal of sulfur dioxide at and above the levels dictated by the NSPS is possible; shown that a lime-based spray dryer can perform successfully in a retrofit mode, removing 70% of the inlet SO/sub 2/; ascertained (from actual operation) that system economics seem to be in line with published estimates; and found from waste studies that there is a dependence of pH upon leachate concentration (but no concentration of elements was high enough to classify wastes from a dry scrubbing system as hazardous).

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REFER ALSO TO CITATION(S) 38903

38804 **(INIS-BR—619) SUPRIR - multibase system for retrospective search.** Lovisi, A.L.M.; Fernandes, C.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. 11p. (In Portuguese). (CONF-8610277—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702456.

From 2. national meeting on librarianship and informatics; 2. national meeting on legal information and documentation; Brasilia, Brazil (26 Oct 1986).

SUPRIR - a retrospective search system developed at the Centro de Informacoes Nucleares (CIN) of the Comissao Nacional de Energia Nuclear (CNEN) is described. The multi-base software structure and the bibliographic data bases in operation under SUPRIR are presented. The utilization of the system, means of access and query formulation are shown.

38805 **(NUREG—0020-Vol.10-No.12) Licensed operating reactors: Status summary report, data as of 11-30-86.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Jun 1987. 439p. NTIS, PC A19 - GPO. File Number DE87900838.

The operating units status report - licensed operating reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 38648, 38823, 38824, 38836, 38885, 38897, 38901, 38902, 38912, 38915, 38922, 38924, 38926, 38927, 38928, 38930, 38933, 38934, 38936, 38937, 38938, 38939, 38940, 38941, 38943, 38944, 38947, 38949, 38959, 38960, 38962, 38963, 38964, 38965, 38966, 38973, 38975, 38978, 38984, 38989, 38990, 38991, 38996

38806 (INIS-mf—10622, pp 27-36) **Operating experiences with BWR-type reactors.** Jaerschky, R. 1980. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243. (CONF-800386—Pt.3).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

In addition to general operating results for all BWR-type reactors, experiences with regard to the operation of the KKI reactor are discussed. In conclusion, details are given about the completed opening of the Philippsburg-1 reactor. Operation by qualified personnel and with instrumentation and control is presenting no problems.

38807 (INIS-mf—10623, pp 1-11) **Practical applications of neutron noise for boiling water reactors.** Behringer, K.; Crowe, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). 1980. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The detection of vibrating in-core instrument tubes and the impacting of fuel element boxes were a problem in which neutron noise analysis substantially contributed. The possibility of detecting bypass flow boiling from neutron noise signatures is a recently proposed concept. Most of the research efforts have been applied to the experimental determination of local characteristics of the two-phase flow which dominates the noise sources in a BWR.

38808 **(JAERI-M—86-101) Reactor fuel performance data file, 1985 edition.** Harayama, Yasuo; Fujita, Misao; Watanabe, Kohji. (Japan Atomic Energy Research Inst., Tokyo). Jul 1986. 209p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87702511.

In safety evaluation and integrity studies of reactor fuel, data on fuel performance are the most basic materials. The Fuel Reliability Laboratory No. 1 has obtained the fuel performance data by joining in some international programs to study the safety and integrity of fuel. Those data have only been used for the studies in the above two fields. However, if the data are rearranged and compiled in a easily usable form, they can be utilized in other fields of studies. A data file on fuel performance is being compiled by adding data from open literatures to those obtained in international programs. The present report is prepared on the basis of the data file compiled by March in 1986.

38809 **(PNL-SA—14680) Characterization of spent fuel disassembly hardware and nonfuel bearing components and their relationship to 10 CFR 61.** Luksic, A.T. (Pacific Northwest Lab., Richland, WA (USA); Oak Ridge National Lab., TN (USA)). Feb 1987. Contract AC06-76RL01830. 9p. (CONF-870306—57). NTIS, PC A02. File Number DE87011142.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

There are a variety of wastes that will be disposed of by the federal waste management system under the Nuclear Waste Policy Act of 1982. The primary waste form is spent nuclear fuel. Currently, this is in the form of fuel assemblies. If the fuel pins are removed from the fuel assembly, as in consolidation, then the fuel pins and the structural portion of the fuel assembly must be considered as separate waste streams. The structural hardware consists of end fittings, grid spacers, water rods (BWR 8 x 8 only), control rod guide tubes (PWR only) and various nuts, washers, springs, etc. These are referred to as spent fuel disassembly (SFD) hardware. There will also be a number of other components which are defined in Appendix E of 10 CFR 961, the standard utility contract. These are referred to as nonfuel-bearing (NFB) components, and include fuel channels (BWR), control rods, fission chambers, neutron sources, thimble plugs, and other components. This paper characterizes spent fuel disassembly (SFD) hardware, and nonfuel-bearing (NFB) components for the most abundant fuel types. The descriptions and figures given are representative for the items described. Many subvariants exist due to design evaluation, which are not covered. This paper also discusses the relationship of these wastes to 10 CFR 61 waste classification.

38810 **(STEV—1986-11) Premature phaseout of the Barsebaeck plant. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 68p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751973.

The effect of the phaseout on the supply of electric power of the country is discussed. The impact on consumption and possibilities of substitution and alternatives are dealt with. The particular effects on the supply of electric power in the South of Sweden are treated and the cost and environmental effects of premature phaseout are presented. (G.B.).

38811 **Plant analyzer development for high-speed interactive simulation of BWR plant transients.** Wulff, W.; Cheng, H.S.; Mallen, A.N. (Brookhaven National Lab., Upton, NY). pp 3.35-3.44 of Proceedings of second international topical meeting on nuclear power plant thermal hydraulics and operations. Wakabayashi, J.; Nariai, H. (eds.). Tokyo, Japan; Atomic Energy Society of Japan (1986). (CONF-860454—).

From 2. international topical meeting on nuclear power plant thermal hydraulics and operations; Tokyo, Japan (15 Apr 1986).

Advanced modeling techniques have been combined with modern, special-purpose peripheral minicomputer technology to develop a plant analyzer which provides realistic and accurate predictions of plant transients and severe off-normal events in nuclear power plants through on-line simulations at speeds of approximately 10 times faster than actual process speeds. The new simulation technology serves not only for carrying out safety analyses routinely and efficiently, optimizating emergency procedures and design changes, parametric studies for obtaining safety margins and for generic training, but also for assisting plant operations. Five modeling principles are presented which serve to achieve high-speed simulation of neutron kinetics, thermal conduction, nonhomogeneous and nonequilibrium two-phase flow coolant dynamics, steam line acoustical effects, and the dynamics of the balance of plant and containment systems, control systems and plant protection systems. Principles for selecting numerical integration techniques are presented, as well as efficient techniques for reducing mathematical operations during the simulation. Available computer architectures are compared with regard to their suitability for simulating complex systems. The AD10 peripheral processor's architecture is presented. The BNL Plant Analyzer is described and simulation results are presented. It is shown that the plant analyzer surpasses supercomputers in simulation speed and produces the same results as large systems codes for a wide variety of transients, but at considerably lower cost than mainframe computers.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 38634, 38648, 38808, 38809, 38836, 38881, 38885, 38892, 38893, 38894, 38895, 38896, 38897, 38898, 38901, 38902, 38906, 38912, 38913, 38915, 38919, 38922, 38923, 38924, 38925, 38926, 38927, 38928, 38929, 38932, 38933, 38936, 38937, 38938, 38939, 38941, 38942, 38943, 38945, 38946, 38947, 38949, 38954, 38956, 38957, 38958, 38959, 38960, 38961, 38962, 38963, 38964, 38965, 38966, 38967, 38968, 38973, 38974, 38975, 38978, 38989, 38990, 38991, 38997, 39633, 39634

38812 **(BMU—1986-106) Joint summarized report of DFK on the safety of the French Cattenom nuclear power station and the German Philippsburg 2 nuclear power station and appendix: Cooling tower effects. Passed on June 4, 1982 (Report) and June 6, 1984 (Appendix).** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Deutsch-Franzoesische Kommission fuer Fragen der Sicherheit Kerntechnischer Einrichtungen (DFK) (Germany, F.R.)). Sep 1986. 14p. (In German). (DFK—82/2(D)). NTIS, PC E07; Available from NTIS as TIB/B87-06266.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The comparison of the investigations carried out in West Germany and in France, which agree in their statements on the propagation behaviour of cooling tower plumes and the associated environmental effects, shows that in both cases possible effects from cooling towers are limited in space and cannot be proved at a distance of several kilometres from the cooling towers.

38813 **(BMU—1986-116) Verification of the OREST (HAMMER-ORIGEN) burn-up program system in post-irradiation analyses of mixed oxide fuels of the Obrigheim reactor.** Hesse, U. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 36p. (In German). (GRS-A—1085). NTIS, PC E07; Available from NTIS as TIB/B87-06364.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The results of post-irradiation analyses for 10 fuel rod samples of KWO mixed oxide fuel elements by OREST calculations were calculated. As the fuel rods were taken from exposed fuel element positions (edge of fuel element, in centre), the previous multidimensional spectrum calculations for a mixed oxide element in a UO/sub 2/ environment were necessary in order to determine the local neutron flux distributions. Using this process of calculation, OREST could determine the uranium and transuranic element isotopes in the burn-up range of 10 to 40 GWd/tSM with sufficient accuracy even if there were greatly different neutron physics conditions locally in the fuel rods. Radiologically important nuclides such as Pu-238, Cm-242 and Cm-244 were determined more accurately by OREST than by other methods of calculation.

38814 **(BMU—1986-117) Verification of the OREST (HAMMER-ORIGEN) burn-up program system in the post-irradiation analyses of fuel elements BE-168, 170, 171 and 176 of the Obrigheim reactor.** Hesse, U. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 35p. (In German). (GRS-A—962). NTIS, PC E07; Available from NTIS as TIB/B87-06456.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The burn-up code OREST has a spectrum code assigned to it, which determines the neutron spectrum in the actual fuel element mixture at the start and during burn-up and carries out the resonance treatment for the most important uranium and transuranic element isotopes. The reliability of the OREST system is shown for UO/sub 2/ burn-up in PWR's. Post-irradiation analyses of five UO/sub 2/ fuel elements of KWO with an initial enrichment of 3.13% by weight of U235 and a mean burn-up of 28.4 GWd/tV are used for comparison. The reliability of OREST information for UO/sub 2/ fuel in PWR's is proved by the good agreement between experiment and calculation, also compared with KfK's results.

38815 **(CNEN-DR-GTT—06/85) DNBR sensitivity analysis using cobra IIIP for Angra 1 NPP.** Galetti, M.R.S.; Debrecin, N. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Nov 1985. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702430.

The results of DNBR sensitivity analysis for NPP Angra 1 are presented in this report. Sensitivity study was carried out using computer code COBRA IIIP, and all the sensitivity factors were calculated for the nominal condition as the reference case. The main objective of this analysis was to make the first effort to analyse the statistical core thermal design method (SCTD) proposed by Westinghouse.

38816 **(CNEN-DR-GTT—07/85) Improved linearized estimative to DNBR for Almod 3W2 code.** Camargo, C.T.M.; Debrecin, N. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Nov 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702431.

DNBR sensitivity analysis of Angra 1 NPP was used to derive the coefficients for an improved linearized estimative to minimum DNBR for the transient code ALMOD 3W2. Four different cases are proposed to demonstrate the adequacy of the correlation when compared with COBRA IIIP results.

38817 **(EPRI-NP—5199-Vol.2) Chemical enhancement of crevice flushing: Volume 2, Data documentation: Final report.** Baum, A.J.; Prestegiacomo, J.B. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Steam Generator Technology Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 405p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920463.

The primary objective of this project was to evaluate the effect of various chemical additives on enhancing the hideout return produced during tubesheet crevice flushing operations in PWR steam generators. Secondary objectives included determining if flushing was an effective means of introducing a corrosion inhibitor into deep tubesheet crevices, and evaluating the effects of different degrees of crevice restriction, different initial crevice chemistries, and different flushing processes. Testing was unable to identify a single additive formulation which increased the flushing effectiveness for all degrees of crevice restriction considered. Testing did reveal that a combination of surfactant (Surfynol 104) and boric acid enhances the flushing effectiveness in tests with moderately restricted crevices. Although cleaning agents were found to increase the flushing effectiveness in tests with extensively restricted crevices, potential corrosion concerns and relatively high contaminant (sodium) levels could discourage their use. However, the testing demonstrated that flushing was an effective means of accumulating a corrosion inhibitor, such as boric acid, in deep tubesheet crevices. Companion testing also indicated that boric acid which accumulated in a tubesheet crevice during crevice flushing was likely to remain in the crevice during subsequent power operation. Consequently, use of boric acid as an additive in tubesheet crevice flushing operations is strongly recommended.

38818 (INIS-mf—10622, pp 37-47) **Operating experiences with PWR-type reactors.** Schenk, H. (Kernkraftwerk Obrigheim G.m.b.H., Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243. (CONF-800386—Pt.3).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The general operating characteristics, time availability experiences with the major components and security at the Obrigheim reactor demonstrate the reliability of the PWR-type reactor.

38819 **(JAERI-M—86-126) Results of eddy current test for second round robin by Halden reactor project.** Iwai, Takashi; Souzawa, Shizuo; Miyata, Seiichi; Sakai, Haruyuki; Sakakura, Atsushi. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702525.

JMTR Hot Laboratory has executed the eddy current test of two PWR type zircaloy cladding tubes for the second round robin by Halden Reactor Project. Defects manufactured on the test specimen were revealed on a fair way to success as a function of local position, phase character and size. Influence of the fatigue crack between the two different tubes was studied through the phase angle analysis. More effort should be needed for detecting rather small internal defects when they are combined with external and other various type of defects.

38820 **(KFK—3768) Post test investigation of the single rod tests ESSI 1-11 on temperature excalation in PWR fuel rod simulators due to the Zircaloy/steam reaction.** Hagen, S.; Kapulla, H.; Malauschek, H.; Katanishi, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Mar 1987. 182p. NTIS, PC E14; Available from NTIS as TIB/B87-08675.

This KfK-report describes the posttest investigation of the single rod tests ESSI-1 to ESSI-11. The objective of these tests was to investigate the temperature escalation behaviour of Zircaloy clad PWR-fuel rods in steam. The investigation of the temperature escalation is part of the program of out-of-pile experiments (CORA) performed within the frame work of the PNS Severe Fuel Damage Program. The experimental arrangement consisted of fuel rod simulator (central tungsten heater, UO/sub 2/ ring pellets and Zircaloy cladding), Zircaloy shroud and fiber ceramic insulation. The introductory test ESSI-1 to ESSI-3 were scoping tests designed to obtain information on the temperature escalation of Zircaloy in steam. ESSI-4 to ESSI-8 were run with increasing heating rates to investigate the influence of the oxide layer thickness at the start of the escalation. ESSI-9 to ESSI-11 were performed to investigate the influence of the insulation thickness on the escalation behaviour. In these tests we also learned that the gap between removed shroud and insulation has a remarkable influence due to heat removal by convection in the gap. After the test the fuel rod simulator was embedded into epoxy and cut by a diamond saw. The cross sections

were photographed and investigated by metalograph microscope, SEM and EMP examinations.

38821 (KFK—4170, pp 567-587) **Safety-related contributions for an FPWR.** Kuczera, B. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Projekt Nukleare Sicherheit). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The general aims for an FPWR and the collaboration between EIR, KWU and KfK are briefly described. The safety-related contributions of KfK concern neutron physics investigations with the further development of the KARBUS program system and work on the PROTEUS experiment, thermal and fluid dynamics subjects for critical heat surface loads of narrow fuel rod arrangements and investigations on fuel element behaviour in loss of coolant accidents (emergency core cooling).

38822 (NUREG/CR—4922) **Steam separator modeling for various nuclear reactor transients.** Paik, C.Y.; Mullen, G.; Knoess, C.; Griffith, P. (Massachusetts Inst. of Tech., Cambridge (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 224p. (EPRI-NP—5272). NTIS, PC A10/MF A01 - GPO. File Number TI87900828.

In a pressurized water reactor steam generator, a moisture separator is used to separate steam and liquid and to insure that essentially dry steam is supplied to the turbine. During a steam line break or combined steam line break plus tube rupture, a number of phenomena can occur in the separator which have no counterparts during steady-state operation. How the separator will perform under these circumstances is important for two reasons, it affects the carry-over of radioactive iodine and the water inventory in the secondary side. This study has as its goal the development of a simple separator model which can be applied to a variety of steam generator for off-design conditions. Experiments were performed using air and water on three different types of centrifugal separators: a cyclone as a generic separator, a Combustion Engineering type stationary swirl vane separator, and a Westinghouse type separator. The cyclone separator system has three stages of separation: first the cyclone, then a gravity separator, and finally a chevron plate separator. The other systems have only a centrifugal separator to isolate the effect of the primary separator. Experiments were also done in MIT blowdown rig, with and without a separator, using steam and water. The separators appear to perform well at flow rates well above the design values as long as the downcomer water level is not high. High downcomer water level rather than high flow rates appear to be the primary cause of degraded performance. Appreciable carry-over from the separator section of a steam generator occurs when the drain lines from three stages of separation are unable to carry off the liquid flow. Failure scenarios of the separator for extreme range of conditions from the quasi-steady state transient to the fast transients are presented. A general model structure and simple separator models are provided.

38823 (STUK-B-YTO—31) **Operation of Finnish nuclear power plants. 2 quarterly report 1986.** Lehtinen, P. (Finnish Centre for Radiation and Nuclear Safety, Helsinki. Dept. of Nuclear Safety). Nov 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751934.

Same report published in Finnish as STUK-B-YTO-33.

These general reviews of the operation of the Finnish nuclear power plants concentrate on such events and discoveries related to reactor and radiation safety that the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment.

38824 (STUK-B-YTO—35) **Safety-related incidents at the Finnish nuclear power plants. 1 and 2 quarterly report 1986.** Lehtinen, P. (Finnish Centre for Radiation and Nuclear Safety, Helsinki. Dept. of Nuclear Safety). Dec 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751935.

Same report published in Finnish as STUK-B-YTO-32.

This report contains detailed descriptions of operating incidents and other safety-related matters at the Finnish nuclear power plants regarded as significant by the regulatory authority, the Finnish Centre for Radiation and Nuclear Safety. In this connection, an account is given of the practical actions caused by the incidents, and their significance to reactor safety is evaluated. The main features of the incidents are also described in the general Quarterly Reports 'Operation of Finnish Nuclear Power Plants', which are supplemented by this report intended for experts. The most important criterion in selecting the events has been the general usefulness of the lessons learned.

38825 **Using a retired Surry unit to assess ISI [in-service inspection] reliability.** Kurtz, R.J. (Battelle Pacific Northwest Lab., Richland, WA, USA). *Nuclear Engineering International;* **32**: No. 390, 37-39(Jan 1987).

Important insights into the reliability of steam generator tube in-service inspection (ISI) techniques are being gained from tests on one of the steam generators removed several years ago from Surry 2. The results of NDE round robins are now being validated by removal and detailed examination of tubes.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 38836, 38843, 38878, 38879, 38891, 38900, 38909, 38911, 38950, 38951, 38975, 38982, 38985, 38987, 38993, 38994, 39211

38826 (INIS-mf—10622, pp 17-26) **Experiences with the AVR reactor.** Ziermann, E. 1980. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243. (CONF-800386—Pt.3).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Experiences from 12 years' operation with the main components, fuel elements, fuelling plant, graphite and carbon internals, shutdown rods, steam generators, blowers and turbines. Experiences in radiation protection show that the discharge levels for inert gases and T are 7.5 x 10/sup 11/ to 1 x 10/sup 12/ Bq per year. The discharge of long-lived aerosols such as strontium 90, cesium 137, iodine 131 and α-emitters is below the detection levels demanded by KTA 1503.1.

38827 (INIS-mf—10693) **Determination of an optimal process control for the incidence of pressure release in an HTR.** Friedrich, K. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 11 Mar 1985. 116p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-09986.

In this dissertation, the methods and models of a newly developed program system are shown, which are particularly suitable for describing the dynamic behaviour and the interaction between the reactor pressure vessel and the reactor protection building of high temperature reactors in normal post-shutdown heat removal operation and in the pressure release accident. Using this program, the maximum pressure release accident is thoroughly examined for an HTR of medium output (about 500 MWe), where after barely 1 1/2 hours (fracture of a NW 65 duct), pressure equalisation occurs between the pressure vessel and the protection building, and there is therefore a possibility of air entering and of graphite corrosion in the pressure vessel. Transients are calculated for the various boundary conditions and the quantities of air entering the pressure vessel due to cooling (contraction) and meteorological air pressure variations are determined. Due to the slow behaviour specific to the HTR, the investigations arrive at the result, that after an automated start of the post-shutdown heat removal systems, the plant can be shut down manually by the control room staff. The investigations showed the following optimum shut-down programme: In the pres-

sure release phase, starting up the blowers depending on reactor pressure vessel pressure, e.g. at 1/2 hour intervals, where the functional connection between the possible blower speed and the pressure vessel pressure is practically independent of the size of the leak.

38828 **(JAERI-M—86-083) Failure mechanisms of coated fuel particles during fabrication.** Minato, Kazuo; Kobayashi, Fumiaki; Kikuchi, Hironobu; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Jun 1986. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702510.

In order to decrease failure fraction of as-fabricated coated fuel particles for HTGR, failure mechanisms of the coated fuel particles during fabrication were studied. More than eight thousand as-fabricated coated fuel particles from seven coating batches were observed by means of X-ray micro-radiography, ceramography, and optical microscopy. Two possible failure mechanisms were suggested through the observations. One of SiC failure mechanisms is that SiC will not deposit on defective inner pyrolytic carbon (IPyC) or gas-permeable IPyC because CO gas generated by carbonization of UO_2 kernel interferes with SiC deposition. The other SiC failure mechanism is that flawed SiC will deposit under undesirable fluidizing condition of the particles and that the flawed SiC is apt to fail because of its low strength. It was also suggested that SiC failure lead to total coating failure easily during fuel compact fabrication. The relation between coating failure and odd shape of the particles was not clear.

38829 **(JAERI-M—86-119) Vibrational characteristics of a coaxial double pipe structure.** Futakawa, Masatoshi; Kikuchi, Kenji. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 57p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702520.

A coaxial double-pipe structure is to be used in the main primary coolant system of a very high-temperature gas-cooled reactor. In order to study the effect of both an axial pitch of spacers and an internal insulation in inner pipe on the vibrational characteristics such as natural frequencies, vibration modes and damping ratios of the coaxial double-pipe structure, vibration tests were carried out by means of hammering on the two kinds of test model : one is called a straight type model and the other an elbow type model. These experimental results were compared with the values calculated by the COSMOS-7 code with a parallel-beam model as well as an equivalent stiffness-beam model. The following are the conclusions derived : (1) Natural frequencies and vibration modes of a coaxial double-pipe structure are predictable by using a parallel beam model. (2) Natural frequencies and vibration modes of a coaxial double-pipe structure depend largely on the locations of spacers. (3) Damping ratios of a coaxial double-pipe structure are larger than those of a single outer pipe.

38830 **(Juel—2085) Integration of coal, steel and nuclear energy. The integrated system 'steam-coal-gasification with HTR-heat and Kloeckner-steel-gas-method', advantages and problems.** Barnert, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1986. 97p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-06455.

The integrated system 'Steam-Coal-Gasification (SCG) and Kloeckner-Steel-Gas-Process (KSG)' for the production of methanol and pig iron on the basis of bituminous coal and nuclear energy in the form of high temperature heat from the HTR is described with balances and cost data. The advantages and the problems of the Integrated System are discussed. It is favourable that a large economic potential is opened up and that economic attractiveness is feasible, compared with the marketing situation of 1984/1985. Of disadvantage is the increased complexity. A brief comment is made on the state of development and potentials of improvements are shown.

38831 **(Juel—2105) High temperature reactor for the production of low temperature heat. Analyses, construction, safety, costs.** Muehlensiep, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Dec 1986. 233p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-08455.

In this report the conditions of nuclear working reactors for district heating are described for the use in suburban areas. The design of a HTR is analysed under the point of view of safety and costs for the components and for the arrangement possibilities. The size of system is chosen by analysing important parameters for construction. The layout is determined by the retention of fission products in the coated particles of the fuel under conditions of hypothetical accidents. Based on stated data a HTR reactor for district heating will be designed. The speciality is a square shaped core which has the advantage to conduct the afterheat fastly to the outside of the pressure vessel in case of hypothetical accidents. Caused by the shape of the core the heat exchangers may be installed next to the core, the shutdown rods are maintained into reflector borings where they have a high efficiency. The whole primary circuit is surrounded by the reactor pressure vessel and is adjusted in an underground concrete cell.

38832 **(Juel-Spez—383) Long-term testing of HTR fuel elements in the Federal Republic of Germany.** Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Dec 1986. 39p. NTIS, PC E07; Available from NTIS as TIB/B87-08452.

The extensive results from irradiation experiments carried out on coated particles, on graphitic matrices of different composition and on integral fuel elements have shown that the spherical fuel elements with high-enriched uranium/thorium mixed-oxide particles and optimized graphitic matrix are available for use in the planned HTR facilities. A concentrated qualification programme is on the way in order to bring the fuel elements with particles from low-enriched uranium dioxide (LEU) and TRISO coating to a comparable level of experience and knowledge, i.e. to make them licensable for the planned HTR facilities.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 38933

38833 **(INIS-BR—614) Holographic NDE of pressure tubes for Cirene nuclear reactor.** Di Chirico, G.; Pirodda, L.; Villani, A. (Cagliari Univ. (Italy); ENEA, Casaccia (Italy). Centro Ricerche Energia). 1985. 4p. (CONF-8512126—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702452.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

Pressure tubes for CIRENE nuclear reactor can be subjected to fretting corrosion of the inner walls. The resulting marks exhibit different geometries, whose influence on the structural behaviour of the tubes has been evaluated by means of a real time holographic technique. The paper shows the results of this investigation. Position and shape of internal defects have been directly visualized by observing holographic fringe distorsions on the outside surface of the tubes. Furthermore, through the fringe patterns, circumferential stress values have also been obtained.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 38592, 38878, 38887, 38899, 38927, 38931, 38933, 38935, 38936, 38996

38834 **(BARC—1182) Development of UO_2-30 WT per cent PuO_2 fuel for FBTR.** Majumdar, S.; Kumar, Arun; Kamath, H.S.; Ramachandran, R.; Purushotham, D.S.C.; Roy, P.R. (Bhabha Atomic Research Centre, Bombay (India)). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702421.

The specifications on fast breeder reactor (FBTR) fuel pellets have two apparently contradictory requirements, viz.; (1) formation of homogeneous solid between UO_2 and PuO_2 which can only be achieved by high temperature sintering and (2) density of sintered pellets in the range of 92 +- 1 per cent T.D. which is normally achieved by low temperature sintering. Deactivation of starting powders under CO_2 or addition of volatile pore formers to the powders are the two methods which have been developed for lowering the density of the pellets without reducing the sintering temperature. Two alternative fabrication routes utilizing these processes for manufacturing of FBTR pellets are described in this report. 5 figures, 1 table.

38835 **(HEDL-SA—3504) CRAW: An expert system for nuclear reactor cover gas alarm analysis.** Zimmerman, B.D.; Rawlins, J.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1986. Contract AC06-76FF02170. 12p. (CONF-860848—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010730.

From National conference on artificial intelligence; Philadelphia, PA, USA (11 Aug 1986).

The CRAW expert system was developed for operational use at the Fast Flux Test Facility research nuclear reactor, which is operated for the Department of Energy by the Westinghouse Hanford Company. The CRAW expert system is based on the EXPERT-EASE commercial expert system development software. It provides "on-the-spot" analysis of the cause of reactor cover gas activity alarms as they are received by Operations personnel in the reactor control room. The CRAW system provides an example of how an expert system can save human time and effort in an operational setting, and also highlights some of the practical considerations of the expert system development process.

38836 **(INIS-mf—10622) Annual meeting on nuclear technology 1980. Technical meeting: Operating experiences.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1980. 50p. (In German). (CONF-800386—Pt.3). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243.

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

In addition to general experiences, experiences in reactor operation with relation to the Phenix reactor, KNK-2 reactor, the AVR reactor, the BWR-type KKI-reactor, the Philippsburg-1 reactor and the Obrigheim reactor are described.

38837 (INIS-mf—10622, pp 1-7) **Experience of five years operation of Phenix.** Conte, F.; Lacroix, A. 1980. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243. (CONF-800386—Pt.3).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Two long periods of exceptional operation have satisfied the hopes of the designers and all parameters, power, efficiency, load factor, fuel behaviour, were better than was expected. The experience resulting from the only major incident provided a series of complementary data. Modern technology has need of sanction by experiment. The Phenix type reactor is a tool which is convenient to operate and to maintain. The two aspects of the demonstration, correct operation and ease of maintenance, take a concrete form in the harmlessness of Phenix on men and on the environment. There is no irradiation and few releases.

38838 (INIS-mf—10622, pp 8-16) **Operating experiences with the KNK-2 reactor.** Brudermueller, G. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752243. (CONF-800386—Pt.3).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Experiences with KNK confirm that a natrium-cooled nuclear power station can be operated sensibly, that relatively few really major problems specific to natrium have been encountered in the KNK reactor and that those problems which do exist, or have existed in the past, are largely historic to KNK or are due to the layout details characteristic of KNK. The gas bubbles problem is also included in this category and should not be considered as typical for natrium reactors.

38839 **(KFK—4199) Velocity and turbulence distributions in wall subchannels of a rod bundle in three axial planes downstream of a spacer grid.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Mar 1987. 76p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08670.

Measurments of the mean velocity, of the wall shear stresses, and of the turbulence have been performed in two wall subchannels (P/D=1.223; W/D=1.183) of a rod bundle of four parallel rods arranged in a rectangular channel for three axial planes. A spacer grid of the SNR-type was inserted in the rod bundle at ratios of distance between the spacer grid and the measuring plane and the hydraulic diameter of L/D/sub h/=40.4, 32.8, and 16.9, respectively. The Reynolds number of this investigation was Re=1.45 x 10/sup 5/. The results show that the distributions of the velocity and of the turbulence are affected by the spacer grid already for L/D/sub h/=40.4. The effects of the spacer grid increase with decreasing distance from the spacer grid.

38840 **(PNL-SA—13704) The development of two phase computer codes for microgravity applications.** Krotiuk, W.J.; Antoniak, Z.I. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 26p. (CONF-861211—20). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003174.

From American Society of Mechanical Engineers winter meeting; Anaheim, CA, USA (7 Dec 1986).

Future space activities will require the development of large power sources. Two-phase alkali metal nuclear reactors appear to be a promising source of this power based on weight, compactness and heat transfer criteria. Consequently, two-phase, microgravity computer codes must be developed to analyze and design the reactor core since the cost of large scale prototype operation in space is prohibitive. This paper presents the results of a comprehensive survey of microgravity, two-phase experiments, outlines the type of microgravity two-phase flow data required to develop the necessary constitutive relations, and describes the approach chosen for the development of microgravity computer codes.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

38841 **(CONF-870102—6) Assessment of ceramic composites for MMW space nuclear power systems.** Besmann, T.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002404.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Proposed multimegawatt nuclear power systems which operate at high temperatures, high levels of stress, and in hostile environments, including corrosive working fluids, have created interest in the use of ceramic composites as structural materials. This report assesses the applicability of several ceramic composites in both Brayton and Rankine cycle power systems. This assessment considers an equilibrium thermodynamic analysis and also a nonequilibrium assessment. (FI)

38842 **(HEDL-SA—3391) Postirradiation examination results from SP-1.** Karnesky, R.A.; Mason, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1986. Contract AC06-76FF02170. 25p. (CONF-860102—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010722.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This paper describes the postirradiation examination results from several of the fuel pins irradiated in the SP-1 test. The SP-1 test is the first of two tests irradiated in EBR-II to be examined. These tests are designed to provide a direct comparison of the per-

formance potential of UO_2 and UN fuel pins under conditions anticipated for the SP-100 reactor. In addition, these tests examine various feasibility issues associated with each fuel system. These issues include: the high temperature swelling behavior of uranium nitride fuel, fuel-cladding compatibility and the potential for UO_2/Li reactions by oxygen diffusion through the cladding.

38843 **(UCRL—95047) Gas-cooled reactor power systems for space.** Walter, C.E. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 4p. (CONF-870102—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014449.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

In this paper the characteristics of six designs for power levels of 2, 10, and 20 MWe for operating times of 1 and 7 y are described. The operating conditions for these arbitrary designs were chosen to minimize system specific mass. The designs are based on recent work which benefits from earlier analyses of nuclear space power systems conducted at our Laboratory. Both gas- and liquid-cooled reactors had been considered. Pitts and Walter (1970) reported on the results of a detailed study of a 10-MWe lithium-cooled reactor in a potassium Rankine system. Unpublished results (1966) of a computer analysis provide details of an argon-cooled reactor in an argon Brayton system. The gas-cooled reactor design was based on extensive development work on the 500-MWth reactor for the nuclear ramjet (Pluto) as described by Walter (1964). The designs discussed here draw heavily on the Pluto project experience, which culminated in a successful full-power ground test as reported by Reynolds (1964). At higher power levels gas-cooled reactors coupled with Brayton systems with advanced radiator designs become attractive.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 38972, 39026

38844 **(DOE/OR/00033—T250) Papers on the nuclear regulatory dilemma.** Barkenbus, J.N.; Freeman, S.D.; Weinberg, A.M. (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1985. Contract AC05-76OR00033. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87004387.

The four papers contained in this report are titled: (1) From Prescriptive to Performance-Based Regulation of Nuclear Power; (2) Nuclear Regulatory Reform: A Technology-Forcing Approach; (3) Improving the Regulation of Nuclear Power; and (4) Science and Its Limits: The Regulators' Dilemma. These four papers investigate issues relating to the long-term regulation of nuclear energy. They were prepared as part of the Institute for Energy Analysis' project on Nuclear Regulation funded by a grant from the Mellon Foundation and a smaller grant by the MacArthur Foundation. Originally this work was to be supplemented by contributions from the Nuclear Regulatory Commission and from the Department of Energy. These contributions were not forthcoming, and as a result the scope of our investigations was more restricted than we had originally planned.

38845 **(NUREG—0040-Vol.10-No.4) Licensee contractor and vendor inspection status report: Quarterly report, October 1986-December 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Quality Assurance, Vendor and Technical Training Center Programs). Feb 1987. 272p. NTIS, PC A12/MF A01 - GPO. File Number TI87900547.

This periodical covers the results of inspections performed by the NRC's Vendor Program Branch that have been distributed to the inspected organizations during the period from October 1986 through December 1986. Also, included in this issue are the results of certain inspections performed prior to October 1986 that were not included in previous issues of NUREG-0040.

38846 **(NUREG—0040-Vol.11-No.1) Licensee contractor and vendor inspection status report: Quarterly report, January 1987-March 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards). May 1987. 232p. NTIS, PC A11/MF A01 - GPO. File Number TI87900815.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from January 1987 thru March 1987. Also included in this issue are the results of certain inspections performed prior to January 1987 that were not included in previous issues of NUREG-0040.

38847 **(NUREG—0540-Vol.9-No.5) Title list of documents made publicly available, May 1-31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jul 1987. 348p. NTIS, PC A15 - GPO. File Number DE87900889.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

38848 **(NUREG—0936-Vol.5-No.3) NRC [Nuclear Regulatory Commission] regulatory agenda: Quarterly report, July-September 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). Jan 1987. 150p. NTIS, PC A07/MF A01 - GPO. File Number TI87900483.

The NRC Regulatory Agenda is a compilation of all rules on which the NRC has proposed or is considering action and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The Regulatory Agenda is updated and issued each quarter. The Agendas for April and October are published in their entirety in the Federal Register while a notice of availability is published in the Federal Register for the January and July Agendas.

38849 **(NUREG—1100-Vol.3-Add.) Budget estimates: Appropriation, Salaries and expenses: Fiscal Years, 1988-1989.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Budget and Analysis). May 1987. 46p. NTIS, PC A03/MF A01 - GPO. File Number TI87900836.

This report contains the fiscal year budget justifications to Congress. The budget provides estimates for salaries and expenses for fiscal years, 1988-1989. This addendum is required due to the NRC reorganization of April 12, 1987.

38850 **(REG/G—1.8-Rev.2) Regulatory Guide 1.8: Qualification and training of personnel for nuclear power plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. 4p. Nuclear Regulatory Commission, Washington, DC 20555. File Number TI87900831.

Paragraph 50.34(b)(6)(i) of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that an application for a license to operate a nuclear power plant include information concerning organizational structure, personnel qualifications, and related matters. Subpart D, "Applications," of 10 CFR Part 55, "Operators' Licenses," requires that operator license applications include information concerning an individual's education and experience and related matters. This regulatory guide describes a method acceptable to the NRC staff for complying with those portions of the Commission's regulations with regard to the training and qualifications of nuclear power plant personnel. Personnel of test, training, research, and mobile reactors are not covered by this regulatory guide.

38851 **(REG/G—1.134-Rev.2) Regulatory Guide 1.134: Medical evaluation of licensed personnel for nuclear power plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. 3p. United States Regulatory Commission, Washington, DC 20555. File Number TI87900825.

This guide describes a method acceptable to the NRC staff for providing the information needed by the staff for its evaluation of the medical qualifications of applicants for initial or renewal operator or senior operator licenses for nuclear power plants and for providing notification to the NRC of an incapacitating disability or illness.

38852 **(REG/G—1.149-Rev.1) Regulatory Guide 1.149: Nuclear power plant simulation facilities for use in operator license examinations.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. 4p. Nuclear Regulatory Commission, Washington, DC 20555. File Number TI87900830.

Paragraph 55.45(a) of 10 CFR Part 55, "Operators' Licenses," requires that an applicant for an operator or senior operator license demonstrate both an understanding of and the ability to perform certain essential job tasks. Paragraph 55.45(b) specifies that these operating tests will be administered, in part, either in a simulation facility consisting solely of a plant-referenced simulator that has been certified to the Commission by the facility licensee or in a simulation facility approved by the Commission after application has been made by the facility licensee. This regulatory guide describes a method acceptable to the NRC staff for complying with those portions of the Commission's regulations regarding (1) certification of a simulation facility consisting solely of a plant-reference simulator and (2) application for prior approval of a simulation facility.

2108 Economics

REFER ALSO TO CITATION(S) 38660, 38796, 38878, 38896

38853 **(STEV—1986-10) Premature nuclear power phaseout in Sweden. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 389p. (In Swedish). NTIS (US Sales Only), PC A17/MF A01. File Number DE87751972.

The conditions prevalent for a phaseout before the year 2010 are discussed. International and indigenous fuel markets are described in order to elucidate the development of prices and the possibilities of increased fuel supply and of a new type of electric power generation. The cost of different power categories and their possible rate of development is estimated and the introduction of new techniques is presented. Electric power and energy balances, power pricing and the development of demand is discussed as well as the chances of the government to control the development and the effect of the phaseout on national economy.

38854 **(STEV—1986-R15) Natural gas - an alternative. Swedish electric power from Norwegian natural gas. After Chernobyl.** (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 87p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751957.

The report describes the possible substitution of electric power by natural gas on the heat source market and how gas can be used for power production. The cost of distribution and means of supply are presented. 1/3 of the electric power produced by nuclear power plants can be replaced by the middle of the nineties. Transport techniques for gas and its total volume as well as transport cost from Norwegian North Sea are discussed.

38855 **(STEV—1986-R19) Energy markets and price relations. After Chernobyl.** Bergendahl, P.A. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 78p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751961.

The aim of the report is to elucidate the way and extent of the dependence of the price of different energy species of one another and particularly of crude oil prices. Oil, coal and natural gas can substitute each other at many applications. The prices are dependent on mining, processing and transporting. Forecasting of prices and future trends are discussed.

38856 **(TKK-SYS—A16) Hierarchical decision aid in a debate on national energy policy.** Haemaelaeinen, R.P.; Seppaelaeinen, T.; Oehladt, K.; Ruusunen, J. (Helsinki Univ. of Technology, Otaniemi (Finland). Systems Analysis Lab.). Dec 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751941.

A wide public depate on the future energy policy of Finland has been going on for the past few years, and at the moment the discussion is centered around the question whether a new nuclear power plant should be built or not. To clarify the differences between anti-nuclear and pro-nuclear opinions, a decision analysis of the issue was conducted with a microcomputer-based decision aid which utilizes the Analytic Hierarchy Process. The participants representing the opposite opinions were the Minister of Finance and a chief industrial executive. This paper presents the preference profiles of the participants and sensitivity analyses of the results, and discusses the implications of the results for the depate. Essential sources of opinion differences are pointed out and a deeper understanding of the issue is gained. This enables focusing the depate on the critical questions and elimination of less important criteria, which otherwise might receive disproportonate attention.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 38821, 40000

38857 **(BARC—1313) Annual progress report for 1985 of Theoretical Physics Division.** Rastogi, B.P. (ed.). (Bhabha Atomic Research Centre, Bombay (India)). 1986. 141p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87702424.

This report presents a resume of the work done in the Theoretical Physics Division during the calender year, 1985. The topics covered are described by their brief summaries. The main fields of the work were: (a) physics design of the 500 MWe PHWR and related developmental studies, (b) reactor physics work related to Rajasthan, Narora and Tarapur stations, (c) laser fusion studies, (d) mathematical physics studies on Monte-Carlo method, transport equation and Fokker-Planck Equation and (e) theoretical physics studies related to Feynman path integrals and quantum optics. The lists of research publications and Trombay Colloquia organised are also appended.

38858 **(IEA—20007/PUMA/R/B) Formal heat transfer solutions in nuclear reactor engineering.** Lach, J. (Institute of Atomic Energy, Otwock-Swierk (Poland)). 1984. 88p. (In Polish). Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, Pl-00-901 Warsaw, Poland.

The problem of unsteady heat transfer between uniformly treated nuclear fuel element and coolant is considered. The analytic solution is found for the case when chemical reactions in coolant appear and when they do not appear. It is assumed that the quantity of absorbed or generated heat may be approximated by a linear function of temperature. These solutions have the form of a sum of product of linear, exponential and some special functions related to the Bessel functions. Although some simplified assumptions are made, the results obtained enable us to carry out basis analyses needed for preliminary project of nuclear reactor core. They provide necessary information concerning the complexity of more complicated mathematical models involved.

38859 **(INIS-mf—10893) Contribution to the design of a 3 dimension simulation for quasistatic evolutions.** Moughari, A. (Commissariat aux Energies Nouvelles, Algiers (Algeria). Centre de Developpement des Techniques de Base). May 1986. 158p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702485.

A 3-dimensions description based on the 1 1/2 group diffusion theory, has been used to model the core. The cross-sections are function of a vector (β-vector) including temperatures, local power, boron and xenon concentrations, and another control vector (α-vector). The reference state cross-sections are given by laser, and the cross-sections for any vector are computed using a first order interpolation formula for β/sub i/ and Gordon interpolation for chi/sub i/. Temperatures variations needed for the above interpolations are calculated using an analytical model with the reference state given by STDY-3. The local flux and the local power for the reference state are determined by a 3-dimensional code Dorning. The xenon concentration is the value at equilibrium and the boron concentration is obtained from criticite. The 3-dimensions code being very expensive, cannot be used at each time and Gordon interpolation is used instead for the calculation between two reference states the flux for any state of the control vector is computed using variational interpolation of Pomraning.

38860 (JAERI-M—86-080, pp 261-269) **Code to calculate multigroup constants for fast neutron reactor.** Wang, Yaoqing; Yu, Peihua. (Academia Sinica, Beijing, China. Inst. of Atomic Energy). Jun 1986. NTIS (US Sales Only), PC A19/MF A01. File Number DE86702697. (NEANDC(J)—120/U; INDC(JPN)—106/L; CONF-8511220—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1985).

KQCS-2 code is a new improved version of KQCS code, which was designed to calculate multigroup constants for fast neutron reactor. The changes and improvements on KQCS are described in this paper.

38861 (JAERI-M—86-125) **Reactor Engineering Department annual report, April 1, 1985 - March 31, 1986.** (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 247p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702524.

Research and development activities in the Department of Reactor Engineering in fiscal 1985 are described. The work of the Department is closely related to development of multipurpose Very High Temperature Gas Cooled Reactor, High Conversion Light Water Reactor and Fusion Reactor, and development of Liquid Metal Fast Breeder Reactor carried out by Power Reactor and Nuclear Fuel Development Corporation. Contents of the report are achievements in fields such as nuclear data and group constants, theoretical method and code development, reactor physics experiment and analysis, fusion neutronics, shielding, reactor and nuclear instrumentation, reactor control and diagnosis, reactor decommissioning technology, and activities of the Committee on Reactor Physics.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 38921, 38976, 38980, 38981, 39197, 39434

38862 (BMU—1986-112) **Basis, possible applications and limits of fracture concepts. 17. Technical report.** Roos, E. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Sep 1986. 169p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-06373.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Based on the available fracture mechanics calculation processes, whose theoretical backgrounds are described in detail, a number of experimentally examined large and small samples and containers could be analysed. In order to obtain information on a wide range of materials, experiments were selected, which cover a range of notch impact work in the high area of 40 J to 200 J. The crack resistance curve based on the J integral was used as the material characteristic in the fracture mechanics process of calculation. The crack starting value is determined from this, for which various methods are used. The container calculations with the empirically derived formulae show a correct, if conservative, estimate of fracture behaviour (leak before break behaviour) and the expected instability load.

38863 (BNL-NUREG—39597) **Soil-structure interaction effects on containment fragilities and floor response spectra statistics.** Pires, J.; Reich, M.; Chokshi, N.C. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). 1987. Contract AC02-76CH00016. 6p. (CONF-870812—10). NTIS, PC A02/MF A01. File Number DE87008717.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The probability-based method for the reliability evaluation of nuclear structures developed at Brookhaven National Laboratory (BNL) is extended to include soil-structure interaction effects. A reinforced concrete containment is analyzed in order to investigate the soil-structure interaction effects on: structural fragilities; floor response spectra statistics and acceleration response correlations. To include the effect of soil flexibility on the reliability assessment the following two step approach is used. In the first step, the lumped parameter method for soil-structure interaction analysis is used together with a stick model representation of the structure in order to obtain the motions of the foundation plate. These motions, which include both translations and rotations of the foundation plate, are expressed in terms of the power-spectral density of the free-field ground excitation and the transfer function of the total acceleration response of the foundation. The second step involves a detailed finite element model of the structure subjected to the interaction motions computed from step one. Making use of the structural model and interaction motion the reliability analysis method yields the limit stat probabilities and fragility data for the structure.

38864 (BNL-NUREG—39762) **DHCVIM: A direct heating containment vessel interactions module.** Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870816—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010462.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

Models for prediction of direct containment heating phenomena as implemented in the DHCVIM computer module are described. The models were designed to treat thermal, chemical and hydrodynamic processes in the three regions of the Sandia National Laboratory Surtsey DCH test facility: the melt generator, cavity and vessel. The fundamental balance equations, along with constitutive relations are described. A combination of Eulerian treatment for the gas phase and Lagrangian treatment for the droplet phase is used in the modeling. Comparisons of calculations and DCH-1 test results are presented. Reasonable agreement is demonstrated for the vessel pressure rise, melt generator pressure decay and particle size distribution.

38865 (EGG-M—34386) **Preservation of natural circulation similarity criteria in mathematical models.** Larson, T.K.; Dimenna, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 43p. (CONF-870816—17). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009720.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

This paper discusses preservation of similitude criteria in current mathematical models used for transient analysis of thermal-hydraulic systems. Input models for the RELAP5 computer code were developed for two simple hypothetical natural circulation systems consisting of a closed loop containing energy generation, energy removal, and flow resistance. The two models differed significantly in geometric scale size. A reference model had components and operating conditions in a range similar to those found in typical nuclear steam supply systems; a scaled model, geometrically much smaller than the reference model, had components that were sized from the reference model using similarity criteria presented in the literature. Steady-state and transient single- and two phase natural circulation calculations were conducted using both models to determine if the model-to-model relationships in time-, pressure

drop-, and velocity scales were in accordance with the relations given in the literature. Results from the calculations and analysis conducted indicate that while the code predicts the expected fundamental effects of geometric scale, there are noteworthy differences in the details of calculations.

38866 **(EPRI-NP—4843-S) Nuclear plant piping criteria and construction costs: Final report.** Landers, D.F. (Teledyne Engineering Services, Waltham, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 83p. (CONF-8412122—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920176.

From Workshop on nuclear piping constructibility; Charlotte, NC, USA (12 Dec 1984).

A workshop on Nuclear Power Piping Constructibility attended by architect-engineers, utilities, fabricators, and nuclear steam system suppliers has identified cost-reducing modifications and improvements in the design and construction of piping systems. Among the measures that can reduce piping costs are: stabilization of design practices and regulations, improvement of acceptance criteria for as-built piping tolerances, reduction of piping supports, increased use of computer-aided construction, and reduction of field changes by making welding acceptance criteria more realistic. Participants categorized and prioritized areas for recommended industry actions involving either available and advanced technology.

38867 **(EPRI-NP—4869-M) Methods for ultimate load analysis of concrete containments: Second phase: Interim report.** Dameron, R.A.; Dunham, R.S.; Rashid, Y.R. (Anatech International Corp., La Jolla, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920301.

This summary report gives an overview of research on the influence of special effects on the ultimate load behavior of concrete containment structures. The special effects analyses that were performed include containment response under combined pressure and temperature, shear dislocation at a major concrete crack, wall discontinuity at the wall-basemat juncture, flawed liner, and thermal buckling. The EPRI-sponsored finite element code, ABAQUS-EPGEN, is utilized as the structural analysis tool in this research. The code was modified to incorporate a constitutive model for plain concrete and models for concrete/liner and concrete/rebar interaction. The report provides a general assessment of local effects mechanisms in concrete containment response to overpressurization.

38868 **(HEDL-SA—3304-FP) Effects of yield variations on strain concentrations in inelastic response.** Severud, L.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1985. Contract AC06-76FF02170. 7p. (CONF-850809—87). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004090.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Simplified and detailed inelastic analyses have been used to assess strain concentrations. Evaluations of beams, cylinders, notched sections, perforated plates, and shells revealed that predictions of inelastic peak strains are sensitive to the choice of yield strength. The extent of sensitivity, however, depends upon the type of structure, the material strain hardening properties, the type of loading, and the level of loading. An assessment of these effects and some guidance on the conditions where they are significant were accomplished.

38869 **(HEDL-SA—3665-FP) Simplified analytical methods and experimental correlations of damping in piping during dynamic high-level inelastic response.** Severud, L.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76FF02170. 12p. (CONF-870812—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007437.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Simplified methods for predicting equivalent viscous damping are used to assess damping contributions due to piping inelastic plastic hinge action and support snubbers. These increments are compared to experimental findings from shake and snap-back tests of several pipe systems. Good correlations were found confirming the usefulness of the simplified methods.

38870 **(INIS-BR—615) Analysis of nuclear reactor pressure vessel flanges.** Oliveira, C.A.N. de; Augusto, O.B. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1985. 4p. (In Portuguese). (CONF-8512126—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702453.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

This work proposes a methodology for the structural analysis of high diameter nuclear reactor pressure vessel flanges. In the analysis the vessel is divided into shell-of-revolution elements, the flanges are represented by rigid rings, and the bolts are treated as beams. The flexibility method is used for solving the problem, and the results are compared with results obtained by the finite element method.

38871 **(INIS-BR—645) Fabrication of nozzles for nuclear components by welding.** Moraes, M.M.; Krausser, P.; Echeverria, J.A.V. (Associacao Brasileira de Soldagem, Sao Paulo). 1986. 15p. (In Portuguese). (CONF-8610259—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702480.

From 12. national technology meeting of welding technology; Campos do Jordao, Brazil (1 Oct 1986).

A nozzle with medium outside diameter of 1000 mm and medium thickness of 150 mm composed integrally by deposited metal by submerged-arc (wire S3NiMo1, 0.5mm) was fabricated in NUCLEP. The nondestructive, mechanical, metallographic and chemical testing carried out in a test sample made by the same procedure and welding parameters, showed results according to specifications established for primary components for nuclear power plants, and the tests presented mechanical properties and tenacity better than similar nozzle samples. This nozzle is cheapest concerning to importations, in respecting to its forged similar. (M.C.K.).

38872 (KFK—4170, pp 483-499) **Fatigue crack growth in reactor structural steels with cyclic thermal shock loads.** Bethge, K.; Munz, D.; Stamm, H. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Zuverlaessigkeit und Schadenskunde im Maschinenbau; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Material- und Festkoerperforschung). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The investigations include thermal fatigue experiments, the fractographic and fracture mechanics analysis and material characteristics experiments. The experimental results on thermal fatigue and the theoretical analyses show that cracks due to repeated thermal shock loads can be reliably evaluated. One of the preconditions for this is that the crack propagation curve specific to the material must be known.

38873 (KFK—4170, pp 525-547) **Development and use of waste air filters for nuclear power stations.** Wilhelm, J.G. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik 2). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The starting point of the work done was faults which were found due to local tests on iodine absorption filters carried out in nuclear power stations, supplemented by laboratory tests of the absorption of active carbon. Investigations were made for determining the sources of the I-131, the physico-chemical form, the filter design and filtering. The survey particularly includes the problems of waste air filtering.

38874 **(SVF—227) Improvements of condenser performance with granulate balls.** Bratthaell, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). May 1986. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751951.

At the nuclear power plant Oskarshamn has during time Nov 1983-Apr 1985 test series been done to investigate the improvements of condensor performance with granulate balls. This type of ball is a normal sponge rubber ball coated with granulated plastic material. This material is, different from carborundum and pumice not abrasive to the tube material. The test results show that granulate balls give an improvement of the overall heat transfer coefficient of 5-7 percent compared to continous cleaning with normal sponge rubber balls. Granulate balls remove the utmost thin coating of organic material that the spong rubber balls are not able to remove and a practically metallic clean surface is established. This has been verified by laboratory inspection of tubes withdrawn from the tube bundle and site inspections of the condenser. When the condenser is cleaned by granulate balls during a period of about three days it is possible to keep the performance at a high level for a long time with continous cleaning with normal sponge rubber balls. After about three days the plastic layer on the balls is practically worned out. The balls have during that time fulfilled their function. The improvement in condenser temperature is 1,0-1,5 degree C. For the 02-turbine this means additional delivered energy of about 15,000 MWh per year.

2203 Fuel Elements

38875 **(NUREG/CR—4718) Experimental support and development of single-rod fuel codes program: Summary report.** Lanning, D.D. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Jan 1987. Contract AC06-76RL01830. 45p. (PNL—5972). NTIS, PC A03/MF A01 - GPO. File Number TI87005170.

This report summarizes the activities and results of the 11-year Experimental Support and Development of Single-Rod Fuel Codes Program, sponsored at Pacific Northwest Laboratory by the US Nuclear Regulatory Commission. The program included irradiation of extensively instrumented test fuel assemblies at the Halden Reactor in Norway and postirradiation examination at Harwell Laboratories in the United Kingdom; ex-reactor studies on gap conductance and fuel rod mechanics; and model development for the FRAPCON-2 fuel performance computer code. Significant results included long-term in-reactor data on fuel temperature, fission gas release, and rod elongation; quantification of the inherent scatter in observed fuel temperatures in replicate rods; and definition and modeling of the thermal and mechanical consequences of fuel pellet cracking and fragment outward relocation. The data obtained are used as benchmark data for fuel performance codes and models throughout the world.

2204 Control Systems

REFER ALSO TO CITATION(S) 38835, 38850, 38852, 38918, 38947, 38979, 38983

38876 **(BMU—1986-102/2) Ergonomic principles of modern information provision on viewing equipment and consequences for their use in nuclear power station control rooms. Vol. 2. Catalogue of variables and performance.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Uebefwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.). Inst. fuer Biomedizin und Ergonomie; Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Abt. Neue Technologien - Kerntechnik (NTK); Dornier G.m.b.H., Friedrichshafen (Germany F.R.). Flugsimulation). Sep 1986. 172p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-06371.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This report volume 2 contains a collection of principles of configuration, which were worked out in the study 'Ergonomic principles of modern information provision on viewing equipment and consequences for their use in nuclear power station control rooms' supported by the Federal Ministry of the Interior. The provision of the catalogue of variables and performance as an event of the assessment of the literature was a necessary precondition for the systematic development of VDU screen representation. This principles of configuration were verified in an expensive experimental investigation. The catalogue offers two accesses to the relevant configuration recommendations. If the requirements which are made of the operator in a certain situation are known, e.g. as a result of a task analysis, the variables to be taken into account in the configuration and the associated configuration recommendations can be found in the performance catalogue. It is, however, always possible to see the individual variables in the alphabetical variables catalogue as regards their use for the configuration of a certain problem. This catalogue reproduces the present state of ergonomic configuration recommendations. In the context of the assessment and the development of VDU representation for use in power station control rooms, work will continue on the present basis.

38877 **(BMU—1986-129) Investigation of special events on control technique devices with regard to requirements for quality assurance measures.** Haunhorst, H.; Hoemke, P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 37p. (In German). (GRS-A—1147). NTIS, PC E07; Available from NTIS as TIB/B87-06447.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The special events which occurred on control technique devices were examined with the aim of showing suitable measures to avoid the causes of failure found. From this, one should deduce to what extent additional quality assurance measures are required, based on experience. The result of the investigation is that no general gaps in quality assurance of control technique devices were found from the evaluation of these events, from which further requirements for QA regulations would be deduced. However, information was found as to which possible sources of faults should be specially taken into account in compiling quality assurance programs, based on experience. These are discussed from the following points of view: Planning, design and construction, manufacture, approval of equipment, mounting, setting to work, operation.

38878 **(DOE/OR/21400—T300) Testimony of Fred R. Mynatt before the Energy Research and Development Subcommittee of the Committee on Science, Space, and Technology, US House of Representatives.** Mynatt, F.R. (Oak Ridge National Lab., TN (USA)). 18 Mar 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008024.

This report provides a description of the statements submitted for the record to the committee on Science, Space, and Technology of the United States House of Representatives. These statements describe three principal areas of activity of the Advanced Reactor Technology Program of the Department of Energy (DOE). These areas are advanced fuel cycle technology, modular high-temperature gas-cooled reactor technology, and liquid metal-cooled reactor. The areas of automated reactor control systems, robotics, materials and structural design shielding and international cooperation were included in these statements describing the Oak Ridge National Laboratory's efforts in these areas. (FI)

38879 **(JAERI-M—86-117) Compatibility of heat resistant alloys with boron carbide, 5. Preliminary evaluation and capsule design for irradiation tests (83M-8J, 84M-38J, -39J).** Baba, Shinichi; Kurasawa, Toshimasa; Endow, Taichi; Someya, Hiroyuki; Tanaka, Isao. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 89p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702519.

This paper includes an experimental result of out-of-pile compatibility and capsule design for irradiation test in Japan Materials Testing Reactor (JMTR). The compatibility between sheath material and neutron absorber materials for control rod devices (CRD) was examined for potential use in a very high temperature

reactor (VHTR) which is under development at JAERI. The purpose of the compatibility tests are preliminary evaluation of safety prior to irradiation tests. Preliminary compatibility evaluation was concerned with three items as follows : 1) lithium effects on the penetrating reaction of Incoloy 800H alloy in contact with a mixture of boronated graphite and lithium hydroxide powders, 2) short term tensile properties of Incoloy 800H and Hastelloy XR alloy reacted with boronated graphite and fracture mode analysis, 3) reaction behavior of both alloys under transient power conditions of a VHTR. It was clear that the reaction rate constant of the Incoloy 800H alloy was accelerated by doping lithium hydroxide into the boron carbide and graphite powder. The mechanical properties of Incoloy 800H and Hastelloy XR alloy reacted with boronated graphite were decreased. Ultimate tensile strength and tensile ductilities at temperatures over 850 deg C were reduced, but there was no change in the proof (yield) stress. Both alloys exhibited a brittle intergranular fracture mode during transient power conditions of a VHTR and also exhibited severe penetration. Irradiation capsules for compatibility test were designed to simulate three irradiation conditions of VHTR: 1) steady state for VHTR, 2) transient power condition, 3) service limited life of CRD. Capsule irradiation experiments have been carried out satisfactorily and thus confirm the validity of the capsule design procedure.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 38902, 38979, 38984

38880 (BARC—1314) Spectral shapes for accelerograms recorded at rock sites. Ghosh, A.K.; Muralidharan, N.; Sharma, R.D. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702425.

Earthquake accelerograms recorded on rock sites have been analysed to develop site-specific response spectra for use in aseismic design. Normalized pseudo absolute acceleration spectra for various values of damping, pertinent to nuclear power plant design in particular are presented. Various ground motion parameters, viz., peak displacement, velocity acceleration for fifty four accelerograms are examined through motion time histories to be used in structural response analysis. The analysis presented in this paper aims at specifying site specific response spectra for earthquake resistant design of structures and generation of spectrum compatible accelerograms. The salient features of the data set have been discussed. 15 references, 2 tables, 20 figures.

38881 (CNEN-DR—133) First atmospheric diffusion experiment compaign at the Angra site. Analysis of the data measured. Nicolli, D. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Jul 1986. 106p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702429.

An analysis of the data measured during the first atmospheric diffusion experiment campaign at the Angra site is presented. Some time before the diffusion experiments, with tritiated water vapor used as a tracer (HTO) could be started, many preparatory studies had to be concluded due to the local complex terrain surrounded by steep hills on three sides and a bay in the southern direction. An introductory account of these previous steps is given. Tritiated water vapor was released from a 100m-high tower and air humidity sampled at 25 locations as far as 1Km downwind of the source. An elaborated isoconcentration analysis indicates the plume spread has a Gaussian distribution in the horizontal plane up to the edge of the site's area bordered by the hill's top (about 1Km far-off). Nevertheless the Gaussian model has a restricted applicability at some parts of the site because of the terrain unevenness. In general, the results are comparable to those obtained in other countries for complex terrain. Meanwhile, the Angra's experiments seem only to validate the Gaussian model for short range dispersion from an elevated source. For releases in the lowest layer, the Gaussian model might not be valid. The isoconcentration analysis strengthens the assumption of sea breeze recirculation on the site.

38882 (CONF-8609126—4) EPRI [Electric Power Research Institute]/ANL investigations of MCCI [molten core-concrete interactions] phenomena and aerosol release. Spencer, B.W.; Gunther, W.H.; Armstrong, D.R.; Thompson, D.H.; Chasanov, M.G.; Sehgal, B.R. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1986. Contract W-31109-ENG-38. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004984.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

A program of laboratory investigations has been undertaken at Argonne National Laboratory, under sponsorship of the Electric Power Research Institute, in which the interaction between molten core materials and concrete is studied, with particular emphasis on measurements of the magnitude and chemical species present in the aerosol releases. The experiment technique used in these investigations is direct electrical heating in which a high electric current is passed through the core debris to sustain the high-temperature melt condition for potentially long periods of time. In the scoping experiments completed to date, this technique has been successfully used for corium masses of 5 and 20 kg, generating an internal heating rate of 1 kw/kg and achieving melt temperatures of 2000C. Experiments have been performed both with a concrete base and also with a cooled base with the addition of H_2/CO sparging gas to represent chemical processes in a stratified layer. An aerosol and gas sampling system is being used to collect aerosol samples. Test results are now becoming available including masses of aerosols, x-ray diffraction, and scanning electron microscope analyses.

38883 (NUREG/CP—0087) Summary report of the symposium on seismic and geologic siting criteria for nuclear power plants . Cummings, G.E.; Bernreuter, D.L.; Murray, R.C.; Savy, J.B. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract W-7405-ENG-48. 45p. (UCID—21039; CONF-8610301—Summ.). NTIS, PC A03/MF A01 - GPO. File Number TI87011025.

From Symposium on seismic and geologic siting criteria for nuclear power plants; Rockville, MD, USA (7 Oct 1986).

This is a summary report of the Symposium on Seismic and Geologic Siting Criteria for Nuclear Power Plants held in Rockville, Maryland, on October 7-9, 1986. The purpose of the symposium was to provide a forum to delineate and examine the issues relating to a proposed revision to Appendix A of 10 CFR Part 100. Appendix A to Part 100 is the basic US Nuclear Regulatory Commission regulation concerning seismic siting criteria for nuclear power plants. Some of the issues discussed at the symposium pertained to incorporating current probabilistic concepts into the regulation, decoupling the OBE and SSE, and revising the definition of basic concepts and parameters. The extent of any revision is yet to be determined.

38884 (RCM—01385) Investigation of aerosol formation during passive afterheat removal. Krebs, K.; Baumgaertner, F. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). Feb 1985. 14p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-08677. .

For the emergency cooling system of a storage facility for high-level radioactive waste of a reprocessing plant, a test rig for studying aerosol formation on a reduced scale has been developed. The vapour of the boiling solution of a waste tank is led through a heat exchanger, the condensate being fed back to the tank. The next step is an NO/sub x/ scrubber. The heat from the condenser is led to an air cooler in a natural-draught stack. At four positions in this system, aerosol samplers are installed. Ca(NO/sub 3/)/sub 2/ serves as the aerosol indicator and is analysed by means of atomic emission spectroscopy.

38885 **(SAND—86-2892C) Importance of environment on high temperature reactor accident chemistry.** Elrick, R.M.; Sallach, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 18p. (CONF-860911—24). NTIS MF A01; 2; GPO Dep. File Number DE87004242.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The Fission Product Reaction Facility used in the High Temperature Fission Product Chemistry Program at Sandia is described. Results of studies using cesium hydroxide and cesium iodide in this facility to simulate the behavior of these fission product species in severe reactor accident environments are described. A model is developed for the observed reaction of CsOH with the oxide formed on stainless steel. Recent observations on the stability of CsI in the presence and absence of an ionizing radiation field are discussed. Surface reaction rate constants for these species in accident environments are presented.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 38842, 38905, 38907, 38908, 38917, 38971, 38983, 38992, 39199, 40266

38886 **(AAEC/E—631) Analysis of hypothetical loss-of-control-arm accidents in HIFAR.** Connolly, J.W.; Clark, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702415.

The reactor power transient produced in the HIFAR materials testing reactor upon severance of a central coarse control arm connecting rod and the subsequent pivoting of the arm out of the core has been calculated for a range of reactor conditions likely to be encountered in normal operation. It is concluded that as long as the remaining arms of the control arm bank can be relied on to suppress the post power peak oscillations in power, the reactor will withstand the consequences of such an accident.

38887 **(HEDL-SA—3380) Overview of planning process at FFTF [Fast Flux Test Facility].** Gadeken, A.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76FF02170. 9p. (CONF-860311—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010721.

From Nuclear power plant maintenance meeting; Salt Lake City, UT, USA (23 Mar 1986).

The planning process at the Fast Flux Test Facility (FFTF) is controlled through a hierarchy of documents ranging from a ten-year strategic plan to a weekly schedule. Within the hierarchy are a Near-Term (three-year) Operating Plan, a Cycle (six-month) Plan, and an Outage/Operating Phase Schedule. Coordination of the planning process is accomplished by a dedicated preparation team that also provides an overview of the formal planning timetable which identifies key action items required to be completed before an outage/operating phase can begin.

38888 **(ORNL/TM—10349) Oak Ridge research reactor quarterly report: October, November, and December 1986.** Hamrick, T.P.; Ford, M.K. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007796.

The ORR operated at an average power level of 29.9 MW for 88.5% of the time during October, November, and December of 1986. The reactor was shut down on ten occasions, two of which were unscheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 89.4% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of two Instrumentation and Controls Change memorandums.

38889 **(ORNL/TM—10350) Bulk shielding facility: Quarterly report October, November, and December 1986.** Hamrick, T.P.; Muggridge, F.E. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007798.

The BSR operated at an average power level of 1564 kW for 22.3% of the time during October, November, and December. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The PCA is shutdown for shim-safety rod magnets and associated electronic components upgrading.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 39211

38890 (INIS-BR—651, pp 14) **Producing reactor of radioisotopes.** Lermontov, M. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil. Div. de Reatores). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 38840

2209 Reactor Safety

REFER ALSO TO CITATION(S) 38596, 38821, 38835, 38846, 38848, 38880, 39383, 39434, 39590, 40319

38891 **(BARC—1316) Results of radioactive fallout measurements in India during May-June 1986.** (Bhabha Atomic Research Centre, Bombay (India)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702427.

Radioactive fallout from the reactor accident on 26th April, 1986 at Chernobyl in USSR was detected at Indian monitoring stations from around the middle of May. The fallout was dominated by volatile fission products, ^{137}Cs, ^{134}Cs, ^{131}I, ^{132}Te and ^{140}Ba-^{140}La as well as ^{103}Ru. The levels reached their maximum in early 4th week of May and started decreasing thereafter. ^{131}I could be detected in goat's thyroid as well as in milk, grass and leafy vegetables. The observed concentrations and estimated radiation doses were all very low as compared to natural background and did not pose any health hazards. 15 references, 9 tables, 6 figures.

38892 **(BMU—1986-103) EDF study of the environmental effects of the Cattenom nuclear power station, 4 units. Comments on the radiological aspects and the site characteristics. Passed on June 27, 1986.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.)). Sep 1986. 39p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06264.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The main point of the EDF study is in the conventional ecological environmental effects. The environmental effects occasioned by radioactivity are only treated globally in the study, without giving details, such as figures, data and methods of calculation. There are no concrete statements regarding environmental effects in Germany; instead, one is referred to the documents of the application for permission to drain off gaseous and liquid radioactive materials. Due to the given annual emission rates of radioactive materials with the emitted air and waste water which are applied for, the TUeV Rhineland (Cologne) made estimates for the effects of these in Germany.

38893 **(BMU—1986-105) Emergency precautions for nuclear power stations on the German/French border, with particular reference to the French Cattenom nuclear power station. Passed on May 28, 1986.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Deutsch-Franzoesische Kommission fuer Fragen der Sicherheit Kerntechnischer Einrichtungen (DFK) (Germany, F.R.)). Sep 1986. 13p. (In German). (DFK—86/2(D)). NTIS, PC E07; Available from NTIS as TIB/B87-06265.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.; With 1 map.

An alarm and information system was set up for Cattenom, based on the regulations for the Fessenheim nuclear power station in Alsace, which, in case of a fault or an accident, makes it possible for the German authorities to take the necessary measures to protect the population immediately. In Article 13, the Treaty provides for information to be given on incidents which do not entail any consequences for the employees in the plant or for the population in the area, but which might worry people in the border region. These events were defined in correspondence between the authorities concerned and include faults in the primary circuit, shut-down of the plant and events which can be seen from outside for example.

38894 **(BMU—1986-107) Information on the safety, radiation, environmental and emergency protection measures at Cattenom nuclear power station. Passed on May 28, 1986.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Deutsch-Franzoesische Kommission fuer Fragen der Sicherheit Kerntechnischer Einrichtungen (DFK) (Germany, F.R.)). Sep 1986. 6p. (In German). (DFK—86/3(D)). NTIS, PC E07; Available from NTIS as TIB/B87-06267.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Before setting to work of the first unit of the Cattenom nuclear power station, there is a summarized assessment available to the public for the safety of the plant (DFK report No. 82/2), the radiological effects (DFK report No. 86/1) and the emergency precautions (DFK report No. 86/2).

38895 **(BMU—1986-109) Safety technology comments on Cattenom nuclear power station.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Baden e.V., Mannheim (Germany, F.R.)). Sep 1986. 106p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06365.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The comments are based on the safety report for the identical Flamanville plant, on the contract documents for the DUP and on results of consultancy by the DFK Working Party and on replies from the French side in the context of a German list of questions. The comments refer to the state in spring 1982. According to the agreement made for the catalogue of questions Cattenom/KKP 2, the 1300 MW Philippsburg II nuclear power station is used as a German comparable plant in these comments. Reference is made to the German comparable plant in the description and assessment of important parts of the plant. The main points of the safety technology comments are in the assessment of site characteristics; the safety technology concept; the derivation of radio-active materials and the radiation exposure in the adjacent German area.

38896 **(BMU—1986-115) Safety technology analysis of thermal recycling in West Germany.** Thomas, W.; Hesse, U.; Kramer, E. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 131p. (In German). (GRS-A—1101). NTIS, PC E11; Available from NTIS as TIB/B87-06457.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The safety technology analyses are based on the planned recycling strategy for plutonium and uranium in PWR's in West Germany. The other boundary conditions, such as cooling time before reprocessing, burn-up, proportion of uranium/plutonium mixed oxide fuel elements in the reactor core, proportion of mixed oxide fuel elements in reprocessing correspond to present plans of the plant operators and DWK. In addition, calculations and balances of quantities of plutonium were done. From this, it is found that cumulatively to the year 2000, one can expect about 50 tonnes of plutonium in separated form. The greater part of this will come from reprocessing work abroad from 1990 onwards. The plutonium produced can be completely returned to PWR's. The storage facility for plutonium at ALKEM in Hanau, is expected to be sufficient until 1990. An extension of storage and manufacturing capacity is required after this. The calculation of recycling steps according to a standard recycling model shows that a state of equilibrium will gradually be established with a loading and unloading quantity of about 20 kg Pu/tSM.

38897 **(BMU—1986-122) Acquisition, compilation and critical analysis of technical specifications and qualification procedures for new-qualification and in-service inspection of safety-related electrical equipment in nuclear power plants.** Gossner, S. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 178p. (In German). (GRS-A—1013). NTIS, PC E14; Available from NTIS as TIB/B87-06372.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The result of the critical analysis of the qualification specifications and qualification procedures can be summarized as follows: 1.) The qualification of safety-related electrical equipment is done in several complementary and overlapping stages: proof of success in operation; type test; suitability test; works tests; setting to work tests; in-service inspection. 2.) All the proofs and tests mentioned have now been laid down in KTA Regulations or draft KTA Regulations or have been agreed between the institutions concerned, as no regional differences or differences specific to certain plants can be found in qualification specifications and methods. 3.) Due to the great participation or responsibility of experts according to paragraph 20 of the Atomic Energy Law, in the context of the qualification tests there are no differences between the nuclear technology regulations and the technical specifications used in practice. 4.) The technical specifications and processes used in qualification are suitable and sufficient to prove the required quality. Improvements are necessary at several points.

38898 **(BMU—1986-124) Possible causes of systematic failure of electricity supplies of redundant components of the safety system and measures for their prevention. Pt. 1. Causes and effects of transitions between different operating conditions.** Schweigert, J. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 100p. (In German). (GRS-A—1175). NTIS, PC E09; Available from NTIS as TIB/B87-06369.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

According to the concept of the mains supply connection and the build-up of the house service and emergency supply system, different operating conditions of the electrical supply of the safety system of nuclear power stations are possible. The transitions between the operating conditions are connected with changes in electrical parameters, due to the effects of which systematic failures of the electricity supply of redundant components of the safety system are possible, if no counter measures are taken. The aim of the investigation is to compile the possible causes of joint failure of the electricity supply of redundant components of the safety systems of nuclear power stations. In this first part, the various operating conditions of the electricity supply are considered and the causes of transitions between the various operating conditions and possible effects of the transitions on the electricity supply of the safety system are systematically analysed. The basis of the investigation is the electricity supply of a German PWR of a new type (KONVOI).

38899 **(BMU—1986-126) Test of structure dynamics analysis methods as regards their applicability in authorisation processes. Pt. 2. Numerical analyses of linear systems.** Jonczyk, J.; Abeln, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 187p. (In German). (GRS-A—806). NTIS, PC E14; Available from NTIS as TIB/B87-06367.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Practical recommendations for an improved safety technology assessment of the analysis processes used for dynamic stresses of mechanical systems due to the effect of earthquakes are introduced in the study. Assessment criteria for a sensible choice of methods of analysis were derived from processes which can be used for the purpose of a safety technology assessment of the dynamic stresses. In this second part of the numerical analyses, a typical pipeline system of a sodium-cooled reactor was subjected to a safety technology assessment of the dynamic stresses. This pipeline system was marked by a large number of inherent frequencies close together and therefore represented a special case. This study gives practical instructions on the differentiated choice of methods of analysis for an improved safety technology assessment of the dynamic stresses in such special cases. The pipeline system was first subjected to multiple excitation due to an earthquake and was dynamically examined by elapsed time method, a simple response spectrum method and a multi-spectrum method (method of weighted response spectra). The pipeline was also dynamically analysed with simple excitation and using some deterministic processes and a stochastic method.

38900 **(BNL—52033) Brookhaven lecture series No. 227: The Chernobyl accident.** Kouts, H. (Brookhaven National Lab., Upton, NY (USA)). 24 Sep 1986. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007040.

This lecture discusses the events leading to, during, and following the Chernobyl Reactor number 4 accident. A description of the light water cooled, graphite moderated reactor, the reactor site conditions leading to meltdown is presented. The emission of radioactive effluents and the biological radiation effects is also discussed. (FI)

38901 **(BNL-NUREG—39222) Impact of Zr metal and coking reactions on the ex-vessel source term predictions of CORCON/VANESA.** Lee, M.; Davis, R.E.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jan 1987. Contract AC02-76CH00016. 27p. (CONF-870816—9). NTIS, PC A03/MF A01 - GPO. File Number TI87005862.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

During a core meltdown accident in a LWR, molten core materials (corium) could leave the reactor vessel and interact with concrete. In this paper, the impact of the zirconium content of the corium pool and the coking reaction on the release of fission products are quantified using CORCON/Mod2 and VANESA computer codes. Detailed calculations show that the total aerosol generation is proportional to the zirconium content of the corium pool. Among the twelve fission product groups treated by the VANESA code, CsI, Ca_2O and Nb_2O_5 are completely released over the course of the core/concrete interaction, while an insignificant quantity of Mo, Ru and ZrO_2 are predicted to be released. The release of BaO, SrO and Ce_2O increase, while the releases of Te and La_2O_3 are relatively unaffected by the Zr content of the corium pool. The impact of the coking reaction on the radionuclide release and aerosol production was found to be insignificant.

38902 **(BNL-NUREG—39637) Impact of Zr metal and coking reactions on the fission product aerosol release during MCCI [Molten Core Concrete Interactions].** Lee, M.; Davis, R.E.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-870816—19). NTIS, PC A02. File Number DE87009142.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

During a core meltdown accident in a light water reactor, molten core materials (corium) could leave the reactor vessel and interact with concrete. In this paper, the impact of the zirconium content of the corium pool and the coking reaction on the release of fission products during Molten Core Concrete Interactions (MCCI) are quantified using CORCON/MOD2 and VANESA computer codes. Detailed calculations show that the total aerosol generation is proportional to the zirconium content of the corium pool. Among the twelve fission product groups treated by the VANESA code, CsI, CsO_2 and Nb_2O_5 are completely released over the course of the core/concrete interaction, while an insignificant quantity of Mo, Ru and ZrO_2 are predicted to be released. The release of BaO, SrO and CeO_2 increase with increased Zr content, while the releases of Te and La_2O_3 are relatively unaffected by the Zr content of the corium pool. The impact of the coking reaction on the radiological releases is estimated to be significant; while the impact of the coking reaction on the aerosol production is insignificant.

38903 **(BNL-NUREG—39850) Modeling and numerical techniques for high-speed digital simulation of nuclear power plants.** Wulff, W.; Cheng, H.S.; Mallen, A.N. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870418—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010756.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

Conventional computing methods are contrasted with newly developed high-speed and low-cost computing techniques for simulating normal and accidental transients in nuclear power plants. Six principles are formulated for cost-effective high-fidelity simulation with emphasis on modeling of transient two-phase flow coolant dynamics in nuclear reactors. Available computing architectures are characterized. It is shown that the combination of the newly developed modeling and computing principles with the use of existing special-purpose peripheral processors is capable of achieving low-cost and high-speed simulation with high-fidelity and outstanding user convenience, suitable for detailed reactor plant response analyses.

38904 **(CONF-860906—20) New perspectives on reactor safety.** Avery, R. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004977.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

Over the past few years a number of changes and new perspectives have come about in our approach to reactor safety. These changes have occurred over a period of time extending from as long ago as 1975, when WASH-1400 came out representing the first major application of probabilistic risk analysis (PRA) to US reactor plants. The period of change has extended from that time to the present, and includes new areas of focus such as safety goals, source term studies, and severe accident policy statement and approaches, including the IDCOR Program. It has also included a greatly increased interest in inherent safety. These areas are discussed in this paper.

38905 **(DEMO—85/6) Assessment of the radiological consequences of the Greek Research Reactor's design basis accident with the use of low enriched uranium.** Kollas, J.G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Sep 1985. 48p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702434.

An analysis of the radiological consequences of the design basis accident in the low enriched uranium fueled 5 MW Greek Research Reactor is presented. For the source term thirty-five isotopes are taken into consideration and conservative figures of fission product release are adopted. To estimate the reactor's consequences for Athens population a CRAC2 consequence model version is used. The results indicate that limiting dose and effects are

respectively the thyroid dose and the thyroid effects induced in the 3,081,000 inhabitants of Athens region.

38906 **(DEMO—85/7) Transfrontier consequences to the population of Greece of large scale nuclear accidents: a preliminary assessment.** Kollas, J.G.; Catsaros, N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jun 1985. 71p. NTIS (US Sales Only), PC A04/MF A01 - Library, Democritus NRC. File Number DE87702435.

In this report the consequences to the population of Greece from hypothetical large scale nuclear accidents at the Kozlodui (Bulgaria) nuclear power station are estimated under some simplifying assumptions. Three different hypothetical accident scenarios, the most serious for pressurized water reactors, are examined. The analysis is performed by the current Greek version of code CRAC2 and includes health and economic consequences to the population of Greece.

38907 **(DEMO—85/12) Comparison of the consequences of the design basis accident of the Greek Research Reactor with those of a serious realistic accident.** Kollas, J.G.; Anoussis, J.N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1985. 30p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702438.

An analysis of the radiological consequences of the design basis and the coolant flow blockage accidents of the Greek Research Reactor is presented. The results indicate that the consequences of the coolant flow blockage accident are practically trivial being 1-2 orders of magnitude lower than the corresponding consequences of the design basis accident.

38908 **(DEMO—86/2) Influence of the operating schedule of the Greek Research Reactor on the radiological consequences of the reactor.** Kollas, J.G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Apr 1986. 30p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702439.

The sensitivity of the radiological consequences of the Greek Research Reactor to the operating schedule of the reactor is assessed in this report. The consequences are due to the occurrence of a postulated accident, a 20% core melt loss of coolant accident. Three different operating schedules are considered: (a) the present 8 hrs/day, 5 days/wk schedule, (b) a 16 hrs/day, 5 days/wk schedule, and (c) a continuous operation schedule. The results of the analysis indicate that there is a direct relation between consequences and duration of operation.

38909 **(DEMO—86/3G) Chernobyl nuclear accident and its consequences in Greece.** (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jul 1986. 124p. (In Greek). NTIS (US Sales Only), PC A06/MF A01 - Library, Democritus NRC. File Number DE87702440.

In this report information about the nuclear accident at Chernobyl and the radioactivity burdening of Greece from the radioactive releases of the accident are presented. The main characteristics of the RBMK-1000 reactor and the flow pattern of the radioactive cloud towards Greece are described, results of radioactivity measurements in Greece concerning the environment and the food chain are given, and some estimations of the population doses and of the expected consequences of the accident are made.

38910 **(DEMO—86/5) Critical examination of emergency plans for nuclear accidents.** Catsaros, N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Aug 1986. 89p. (In French). NTIS (US Sales Only), PC A05/MF A01 - Library, Democritus NRC. File Number DE87702441.

An analysis of emergency plans of various countries for nuclear installations on- and off-site emergency preparedness is presented. The analysis is focused on the off-site organization and countermeasures to protect public health and safety. A critical examination of the different approaches is performed and recommendations for effectiveness improvement and optimization are formulated.

38911 **(DEMO—86/9) Consequences of the Chernobyl nuclear accident in Greece - Report No. 2.** (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1986. 24p. NTIS (US Sales Only), PC A02/MF A01 - Library, Democritus NRC. File Number DE87702442.

7 maps.

In this report a realistic estimate of the radioactive fallout on Greece from the Chernobyl nuclear accident is described. The measurements performed on environmental samples and samples of the food chain, as well as some realistic estimations for the population doses and the expected consequences of the accident are presented. The analysis has shown that the radiological impact of the accident in Greece can be considered minor.

38912 **(EFN—20) Safety of light water reactors.** Pershagen, B. (Energiforskningsnaemnden, Stockholm (Sweden)). Apr 1986. 458p. (In Swedish). NTIS (US Sales Only), PC A20/MF A01. File Number DE87751965.

The book describes the principles and practices of reactor safety as applied to the design, regulation and operation of both pressurized water reactors and boiling water reactors. The central part of the book is devoted to methods and results of safety analysis. Some significant events are described, notably the Three Mile Island accident. The book concludes with a chapter on the PIUS principle of inherent reactor safety as applied to the SECURE type of reactor developed in Sweden. (G.B.). With 280 refs.

38913 **(EPRI-NP—4786-Vols.1-2) Loss-of-feedwater, steam generator tube rupture, and steam line break experiments: Steam generator transient response test program: Interim report.** Mendler, O.J.; Takeuchi, K.; Young, M.Y. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.; Nuclear Regulatory Commission, Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 105p. (NUREG/CR—4751-Vols.1-2; WCAP—11206-Vols.1-2). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920242.

Includes 7 sheets of 24x reduction microfiche.

The Westinghouse Model Boiler No. 2 (MB-2) steam generator test model at the Engineering Test Facility in Tampa, Florida, was reinstrumented and modified for performing a series of tests simulating steam generator accident transients. The transients simulated were: loss of feed flow, steam generator tube rupture, and steam line break events. This document presents a description of (1) the model boiler and the associated test facility, (2) the tests performed, and (3) the analyses of the test results. Two LOF tests were analyzed in detail. Both tests were initiated from 100% power condition by shutting off the main feedwater flow. In LOF Test No. 1, the remaining boundary conditions were kept constant while in LOF Test No. 2, the power was rapidly reduced to 3%. The results show that the primary to secondary heat transfer becomes degraded when the collapsed water liquid level in the bundle region falls below approximately 50 inches. The SGTR test analyzed in detail - SGTR Test No. 2 - simulated the post-reactor-trip portion of the SGTR transient (T/sub prim/ = 560°F). The transient was initiated by starting the SGTR flow injection and simultaneously shutting off the auxiliary feedwater. The water level rose and flooded the dryer to its mid-elevation by the end of the test. The primary carry-over was shown to be less than 0.4% of the tracer mass injected into the secondary side by the SGTR flow. SGTR Test No. 3 investigated the response of the intact steam generator. Reverse heat transfer and low heat flow conditions were simulated. The results have demonstrated the occurrence of temperature stratification in the secondary water which lasted for about 800 seconds.

38914 **(EPRI-NP—5024) Seismic ruggedness of aged electrical components: Final report (Phase 2).** Gleason, J.F. (Wyle Labs., Huntsville, AL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 172p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920261.

Seismic tests on new and aged components have shown that, for many types of commonly used nuclear plant electrical components, deterioration due to aging does not significantly affect the ability of the components to function during and after a seismic event. This was demonstrated for capacitors, circuit breakers, contactors (motor starters), control station assemblies, electronic alarms, electronics, fuses, fuse blocks, inductors, meters, motors, pressure transmitters, power supplies, relays, RTDs, solenoid valves, terminal blocks, time delay relays, transformers and switches. A few switch types (limit, pressure and rotary) were observed to be more prone to contact chatter in an aged condition than in an unaged condition. However, the ability of these devices to switch during and after shaking was not affected by aging. These results can be referenced to eliminate the cost of aging prior to seismic qualification testing for many types of electrical components.

38915 **(EPRI-NP—5096) A study on snubber elimination using energy absorbers: Final report.** Khalafallah, M.Z.; Lee, H.M.; Dong, M.Y.; Wilkenson, R.C. (Bechtel Western Power Corp., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 79p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920313.

This report summarizes the results of a snubber elimination study performed by Bechtel Power Corporation (Bechtel) using energy absorbers. Energy absorbers are used here as one of three separate snubber elimination/optimization methods evaluated by independent contractors in a coordinated EPRI program. As a starting baseline, each method considers systems selected from existing operating plants, which were originally designed with snubbers. Energy absorbers used in this study were developed by Bechtel based on earlier success in experimentally demonstrating the concept of energy absorbing restraints on the shaker table at the University of California at Berkeley. ASME code Case N-420 provides rules for construction of energy absorbers under the provisions of Section III of the code. First applications of energy absorbers to nuclear plants are currently being reviewed by the NRC on the Peach Bottom Atomic Power Station and the Point Beach Atomic Plant.

38916 **(EPRI-NP—5223) Generic seismic ruggedness of power plant equipment: Final report.** Smith, C.B.; Merz, K.L. (Anco Engineers, Inc., Culver City, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 246p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920464.

This report presents the results of a program with the overall objective of demonstrating the generic seismic adequacy of as much nuclear power plant equipment as possible by means of collecting and evaluating existing seismic qualification test data. These data are then used to construct "ruggedness" spectra below which equipment in operating plants designed to earlier earthquake criteria would be generically qualified. The report gives the methodology for the collection and evaluation of data which are used to construct a Generic Equipment Ruggedness Spectrum (GERS) for each equipment class considered. Associated with each GERS are inclusion rules, cautions, and checklists for field screening of in-place equipment for GERS applicability. The collected data is available as a computerized Electric Power Research Institute data base accessible to utilities. A GERS provides a measure of equipment seismic resistance based on available test data. As such, a GERS may also be used to judge the seismic adequacy of new or replacement equipment or to estimate the seismic margin of equipment reevaluated with respect to earthquake levels greater than considered in the original design. Twenty-five equipment classes have been considered to date, resulting in nineteen finalized GERS.

38917 **(HEDL-SA—3453) FFTF criteria for run to cladding breach experiments.** Van Keuren, J.C.; Heard, F.J.; Stepnewski, D.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1985. Contract AC06-76FF02170. 24p. (CONF-860610—38). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010731.

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The review of experiments proposed for irradiation in FFTF resulted in the development of new criteria for run-to-cladding breach experiments. These criteria have allowed irradiation of aggressive experiments without compromising the safety bases for FFTF. This paper consisting of a set of narrated slides, discusses these criteria and related bases.

38918 **(HEDL-SA—3511-FP) Expert system technology for control integration in nuclear reactors.** Stabler, E.P. Jr.; Zimmerman, J.J.; Stratton, R.C. (Quintus Computer Systems, Palo Alto, CA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76FF02170. 13p. (CONF-8604297—1). NTIS MF A01; GPO Dep. File Number DE87004438.

From 16. international workshop on expert systems and their applications; Avignon, France (28 Apr 1986).

This report describes the role of expert system technology in nuclear power plant operation. The use of computers to assist operator decisions would greatly enhance the safety and efficiency of operation. A description of the necessary operator interfaces, data acquisition and validation, plant status and parameter diagnosis, and system reliability is presented. (FL)

38919 **(IAEA-TC—579/14) PWR [pressurized water reactor] severe fuel damage phenomena: UK contribution to the fuel pin liquefaction modelling.** Lillington, J.N.; Lyons, A.J. (UKAEA Atomic Energy Establishment, Winfrith). [1987]. 26p. NTIS (US Sales Only), MF A01. File Number DE87900494.

Under extreme loss of cooling conditions for an extended period, a reactor core will heat up due to nuclear or chemical heating and this may lead to core degradation and a serious accident. This paper will address the issues relevant to a PWR and consider the completeness of the data-base and models used in fuel damage codes with particular reference to SCDAP and MELPROG. These codes have been obtained via agreements with the USNRC and the UK is contributing to their development and application. The progress of a PWR severe accident is strongly influenced by the Zircaloy/steam and Zircaloy/fuel reactions. The former produces significant additional heat and hydrogen. There may also be an additional reaction between the Zircaloy and control rod materials (Silver and Indium). The latter leads to fuel erosion and subsequent relocation of Zr-U-O eutectic material to the lower vessel regions. The paper concentrates on the latter related mechanisms and models.

38920 **(INIS-mf—10614) Velocity measurement methods for water-steam flows by correlations of superposed temperature disturbances (range: $0.01 < v < 50$ m/s).** Immink, J.; Stinner, W. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Kerntechnik). Aug 1984. 120p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06104.

Emphasis was put on the extensive automatisation of the measurement and evaluation procedure by making use of mini-computers and problem-optimized hardware (amplifiers, correlator). The range of application was expanded to very slow flows (for example natural circulation, flow reversal), if necessary with pseudostochastic controlled injection of tracer-fluid.

38921 **(INIS-mf—10616) Experimental and theoretical investigations of the resistance of reinforced concrete slabs to the impact of hard missiles. 1. Technical report.** Ruediger, E.; Renz, E.; Riech, H. (Hochtief A.G. fuer Hoch- und Tiefbauten, Frankfurt am Main (Germany, F.R.). Abt. Kerntechnischer Ingenieurbau). Mar 1984. 207p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752239.

The main effort of the test evaluation of the German part consists in calibrating and improving an analytical model set up by Hochtief for calculating the impact of hard projectiles striking upon reinforced concrete slabs. This analytical model idealizes the impact process by splitting it into an initial phase - characterized by penetration of the projectile into the reinforced concrete slab - and a subsequent shear failure phase - characterized by the formation of a shear cone. The report summarizes characteristic test data of the small scale UKAEA tests, summary of the Meppen test data and test layout including the measurement equipment and the design and construction of test target and projectile test results of the Meppen test III/1, description of the analytical model and the calculation procedure and results of the test evaluation.

38922 **(INIS-mf—10620) Annual meeting on nuclear technology 1982. Technical meeting: Possibilities and effects of serious reactor accidents.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1982. 97p. (In German). (CONF-8205205—Pt.2). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752241.

From Meeting on nuclear technology; Mannheim, F.R. Germany (4 May 1982).

A critical examination of the forecast of a design basis accident, the view of the Sandia National Laboratory on the probability of a steam explosion after a core meltdown accident is comparison with WASH-1400, the possibilities of interactions with the containment structure and fission product release, as well as the influences for the assessment of risk in Germany taken from the analysis of core meltdown accidents are dealt with in these papers.

38923 (INIS-mf—10620, pp 1-28) **Series of incidents leading to reactor breakdown and possibilities for controlling such.** Mayinger, F. (Technische Univ. Muenchen, Germany, F.R.). 1982. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752241. (CONF-8205205—Pt.2).

From Meeting on nuclear technology; Mannheim, F.R. Germany (4 May 1982).

A critical investigation of the forecast of a design basis accident showed that no major core damage will result, even if the limits set down in the licensing procedure are exceeded. Only a complete and long-term breakdown of the emergency cooling systems would lead to such damage occurring. The probability of this, however, is considerably smaller than assumed in the risk analyses, since there it is assumed that a core meltdown will occur as soon as the limits set down in the Reactor Safety Commission Guidelines are exceeded (system failures in cases of large/small leaks, disintegration).

38924 (INIS-mf—10620, pp 29-47) **Current perspective on the risk significance of steam explosions.** Snyder, A.W. (Sandia National Labs., Albuquerque, NM, USA). 1982. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752241. (CONF-8205205—Pt.2).

From Meeting on nuclear technology; Mannheim, F.R. Germany (4 May 1982).

The view currently held in the Sandia National Laboratory is that, in the case of a meltdown in the reactor core, the probability of a steam explosion is greater than was estimated in WASH-1400, but that the extent and effect of an explosion will be very much smaller than assumed in WASH-1400. This results in a far smaller total risk with regard to containment. In WASH-1400, a nominal conditional probability of 1% was assumed for a containment rupture in a PWR-type reactor, should a large part of the reactor fuel be subject to meltdown during the course of the accident. The German risk analysis study 'Deutsche Risikostudie Kernkraftwerke' dated 1979 considers an explosion of a size sufficient to represent a threat to containment to be considerably more improbable than was assumed in WASH-1400.

38925 (INIS-mf—10620, pp 48-72) **Interactions with the containment structure and fission product release in case of a core meltdown accident.** Hosemann, J.P. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Projekt Nukleare Sicherheit). 1982. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752241. (CONF-8205205—Pt.2).

From Meeting on nuclear technology; Mannheim, F.R. Germany (4 May 1982).

As little as 0.2% of the inventory of a PWR-type reactor (without water) is made up of fission products and decay products. Only about one third of these are radioactive. A dominant role in the consequences of the accident is not played by water detonation, but rather by the time reaction of aerosol disintegration, since after a few days the hold-up capacity of the safety vessel as the last barrier to release of such to the outside is lost. This depends to a critical extent on the point of time at which the excess pressure failure and therefore the concrete/melt interaction occurs. The BETA experiment is being set up to examine this point.

38926 (INIS-mf—10620, pp 73-95) **Inferences for risk assessment resulting from the analysis of core melt accidents.** Heuser, F.W.; Hippe, D. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Koeln, Germany, F.R.). 1982. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752241. (CONF-8205205—Pt.2).

From Meeting on nuclear technology; Mannheim, F.R. Germany (4 May 1982).

The analysis of incidents of breakdown based on best-estimate calculations leads to a clear reduction in the frequency of the occurrence of core meltdowns. The fission product retention by the safety vessels is of crucial importance. There are still unsolved problems with regard to the H/sub 2/ complex and high pressure. Sample calculations with regard to release via leakages in the safety vessel (steam explosion) show that a retention of fission products in the annulus and other parts of the plant contribute to a limitation in accident consequences. These are provisional results arising from phase B of the German Risk Analysis Study.

38927 **(INIS-mf—10621) Annual meeting on nuclear technology 1981. Technical meeting: Structural stresses as a result of shock waves.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1981. 85p. (In German). (CONF-810326—Pt.1). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242.

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

An examination is made of the influence of shock waves in connection with the safety considerations, the safeguarding of pipelines for dynamic loads with regard to elasticity and plasticity, the effects encountered in fluid-filled, plasticifying pipelines, the dynamic stresses placed on reactor pressure vessel internals in case of blowdown and the parts of the plant relevant to safety.

38928 (INIS-mf—10621, pp 1-14) **Investigation of structural stresses as a result of shock waves within the framework of safety observations at nuclear power stations.** Brosche, D. (Bayernwerk A.G., Muenchen, Germany, F.R.). 1981. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242. (CONF-810326—Pt.1).

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

The technical aspects for the examination of structural stresses caused by shock waves in nuclear power stations are dealt with in the light of the different applications, such as stresses on reactor pressure vessel internal, pipelines and building structures. Consideration is also given to the technical measures resulting from such examinations, as, for example, additional pipeline supports. The considerable influences on nuclear licensing procedures and project management are taken into consideration, as is the evaluation of this complex of problems with regard to the balance between the safety concept and plant requirements.

38929 (INIS-mf—10621, pp 15-34) **Dynamic stresses on reactor pressure vessel internals at blowdown.** Krieg, R.; Schumann, U. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorentwicklung). 1981. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242. (CONF-810326—Pt.1).

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

Wave dispersion phenomena which are founded on the compressibility of the fluid (coolant) do not usually play a dominant

role. Wave dispersion phenomena which are founded on the flexibility of the structure or the fluid-structure interaction, on the other hand, are usually of considerable significance. The realization that the compressibility of the fluid can frequently be disregarded leads to a considerable simplification of the theoretic models and calculation programs. So, for example, a three-dimensional analysis on the stress placed on the core supports can be carried out at an acceptable expense. On the other hand, the result is that, when compressibility is taken into consideration, the method of virtual fluid masses or the observance of only one wave cycle is not generally sufficient.

38930 (INIS-mf—10621, pp 35-52) **Strain and expansion safeguards in pipelines for dynamic loads with extremely low probability of occurrence.** Habedank, G.; Habip, L.M.; Hess, J. 1981. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242. (CONF-810326—Pt.1).

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

Using the example of an assumed case of stress on a feedwater pipe due to a pressure surge, a demonstration is given that this incident can be safely controlled using an elasto-plastic calculation and safeguarding with expansion criteria without it being necessary to install active components, i.e., collision brakes, or fixed locating points, which cause additional obstructions. Prospects are given for the use of the application in other cases of failure and with other components.

38931 (INIS-mf—10621, pp 53-65) **Behaviour and effects of shock waves in fluid-filled, plasticifying pipelines.** Dumm, K.; Kellner, A. (Internationale Atomreaktorbau G.m.b.H., INTERATOM, Bergisch Gladbach, Germany, F.R.). 1981. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242. (CONF-810326—Pt.1).

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

ROPLAST provides an experimentally verified code of calculation to describe the elastic-plastic interactions between shock waves in the fluid and pipe wall structures. Calculations with monaxial stress-expansion correlations or with a suitable modification of this characteristic curve for the consideration of multiaxial stresses are given to supplement the experimental results. In order to determine the shock wave load transported by a plasticifying pipeline system on a subsequently placed component - for instance, the intermediate heat exchanger in SNR-300 - the recommendation is made that calculations should be based on the 'biaxial' correlation, since this leads to the smallest reduction in the transported pressure.

38932 (INIS-mf—10621, pp 66-83) **Influence of shock waves as a result of assumed vessel failure on parts of the plant relevant to safety.** Danisch, R.; Graubner, U. (Kraftwerk Union A.G., Erlangen, Germany, F.R.). 1981. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752242. (CONF-810326—Pt.1).

From Annual meeting on nuclear technology (Jahrestagung Kerntechnik); Dusseldorf, F.R. Germany (24 Mar 1981).

The shock wave induced rupture is of subordinate importance for the laying out of the parts of the plant relevant to safety. It is covered by the precautions for maximum potential earthquakes, aircraft crashes and chemical explosions. The failure of vessels in the power house (WAZUe, SPWB) as the result of a maximum potential earthquake is extremely improbable. If a combination of the stresses resulting from maximum potential earthquakes with the hypothetical stresses resulting from vessel failure is undertaken, it can be seen that the total stresses are only increased by a minimal amount, due to the quadratic averaging of less than 3%.

38933 **(INIS-mf—10623) Annual meeting on nuclear technology 1980. Technical meeting: Early detection methods.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1980. 61p. (In German). (CONF-800386—Pt.4). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244.

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The practical methods refer to the neutron noise analysis of BWR-type reactors, the development and implementation of an early detection system for BWR-type reactors and the possibilities of the noise analysis in natrium-cooled fast breeder reactors. The mathematical methods are concerned with the stochastic analysis, high-frequency acoustic monitoring and early detection of damage in PWR-type reactors.

38934 (INIS-mf—10623, pp 12-21) **Development and implementation of a damage early detection system for BWR-type reactors.** Grondey, G.; Gebureck, P. (Hannover Univ., Germany, F.R. Inst. fuer Kerntechnik). 1980. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Based on the experiences made with off-line frequency and correlation analyses of in-core signals in various nuclear power stations, an on-line measurement system was developed for the compilation, processing, representation and monitoring of in-core measurements with the goal of enabling early detection of damage in light water reactors. The MONAS system (Multi-Channel On-Line Noise Analysis System) is in operation in the Wuergassen nuclear power station. For an interpretation of the signals, the theoretic interpretation of the normal signals must be followed up.

38935 (INIS-mf—10623, pp 22-29) **Possibilities of noise analysis for the purpose of early detection of damage in natrium-cooled fast breeder reactors.** Edelmann, M. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The basic possibilities of early detection of damage by means of noise analysis in fast breeder reactors emerge from an observation of the development of damage and from the nature of the noise analysis on the one hand. On the other hand, parallels between thermal breeders and fast breeder reactors permit a partial application of investigation results and practical conclusions with regard to the possibilities of early detection of damage for both types of reactors. All things considered, specific investigations of experimental quick breeder reactors and on fuel element models, as well as theoretical examinations on failures relevant to safety, have provided explicit proof that the noise analysis has great potential for the early detection of damage in the quick breeder reactors of the future. Provisions have already been made for reactor monitoring systems based on the noise analysis to be included in the French Superphenix reactors now under construction.

38936 (INIS-mf—10623, pp 30-40) **Methods of stochastic analysis - reactor monitoring technology and detection procedure.** Wach, D.; Saedtler, E. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The points under discussion in this paper are the most important analysis procedures for stochastic measurement signals and the reactor monitoring techniques and programs under current application. Due to the stochastic characteristics of the basic information, methods for statistical pattern recognition or for the theory of decision are necessary if corresponding signal processing techniques via logical connections or threshold discriminators are not sufficient to permit an automatic classification. With the assistance of such, it is possible to recognize not only the deviations in the estimated readings of the pattern functions which are determined by the final time of analysis, but also any changes which are brought about by the statistical occurrence of noise waves involved in the process.

38937 (INIS-mf—10623, pp 41-50) **Methods of measurement and analysis for the purpose of early detection of damage in PWR-type reactors.** Bastl, W. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Almost all monitoring procedures are based on the comparison of actual patterns with reference patterns which correspond with an intact system standard. The actual information is to be found in deviations in the pattern functions from the reference functions. GRS is particularly involved with vibration monitoring, loose part detection and the monitoring of leaks.

38938 (INIS-mf—10623, pp 51-59) **Status of high-frequency monitoring in early detection procedures.** Eisenblaetter, J.; Jax, P. (Battelle-Institut e.V., Frankfurt am Main, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752244. (CONF-800386—Pt.4).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The high-frequency acoustic investigations refer to the monitoring of leaks and crack propagation and the development of cracks. A systematic investigation with regard to the optimum range of frequencies is not yet available.

38939 **(INIS-mf—10624) Annual meeting on nuclear technology 1980. Technical meeting: Shock wave propagation processes.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1980. 84p. (In German). (CONF-800386—Pt.2). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240.

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The papers deal with shock wave propagation processes in LWR-type reactors (licencing procedure) in cases of ruptures in vessels, in pipes and high-pressure valves, in case of loss of coolant accidents with dynamic structure coupling or fluid structure interactions in the reactor core jacket and the fuel rods, as well as with the stresses placed on reactor pressure vessel fittings by depressurization waves.

38940 (INIS-mf—10624, pp 1-12) **Stresses on reactor pressure vessel internals by depressurization waves in case of loss of coolant accident without structure dynamic coupling.** Stegemann, D.; Valero, M. (Hannover Univ., Germany, F.R. Inst. fuer Kerntechnik). 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

Within the framework of safety analyses to examine the subsequent strengthening of KWL-type power stations, the stresses placed on reactor pressure vessel internals by depressurization waves in the case of a loss of coolant accident were investigated. Initiated by this assignment, advancements were also made in the computer calculation methods generally applicable in this complex of problems.

38941 (INIS-mf—10624, pp 13-20) **Shock wave propagation processes in LWR-type reactors and their treatment in the nuclear licensing procedure.** Brosche, D. (Bayernwerk A.G., Muenchen, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The implementations are restricted to the fluid mechanics in connection with the shock wave propagation process. In cases of reaction coupling between fluid and adjacent internals, attention is drawn to the special points connected with this. Shock wave propagation processes lead to stresses placed on pipes, pressure vessels, internals, valves and other components. The results of fluid mechanics calculations are input data for the corresponding stress or endurance analyses in case of the components concerned, whereby the statements made in these analyses, including any technical measures which might become necessary, are - in the final analysis - the decisive statements in the course of establishment of proof in reactor licensing procedure.

38942 (INIS-mf—10624, pp 21-30) **Numeric calculation of shock wave propagation processes in case of loss of coolant accidents with structure dynamic coupling.** Rott, W. (Kraftwerk Union A.G., Erlangen, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

The complex shock wave propagation process, which is furthermore determined by dynamic structure interaction, is almost impossible to be reproduced in detail. Therefore, in order to allow calculation by approximation, simplified mathematical models have to be developed. In cases of ruptures in the primary coolant circuits in the cord lane, the strongest shock waves are to be expected in the remaining part of the primary coolant circuit which is still connected to the reactor pressure vessel - the blowdown nozzle. The further one goes from the rupture point, the weaker the loss in pressure will be. The strongest interaction between fluid and structure will therefore be to be expected in the annulus, this due to the fact that the core jacket prevents any fluid from flowing through. On the contrary, it acts as a piston in radial flow. It can be seen from this that the blowdown nozzle and the annulus area will have to be modelled with particular care (series program FLEXWALL).

38943 (INIS-mf—10624, pp 31-40) **Pressure wave propagation processes in case of assumed bursting of containers.** Boekemeier, V.; Diesselhorst, T. (Kraftwerk Union A.G., Erlangen, Germany, F.R.). 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

If the intrinsic influences exerted on shock wave development and propagation are taken into consideration, the uncomplicated and analytical method of calculation provides, in the final analysis, conservative results for the stresses which have to be discharged in the direct area in cases of tank ruptures.

38944 (INIS-mf—10624, pp 41-60) **Shock wave propagation processes in pipelines - experimental and mathematical results of the HP-valve trials.** Grillenberger, T. 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

In case of quick-closing back-kick valves after a blowdown, severe stresses can occur in the feed-water pipes as a result of pressure surfes. By means of absorption measures (closing times > 0.25 sec.), the stress can be reduced. The series programs, which simulate the dynamic behavior of the valves together with the fluid mechanics, are in a position to enable a correct calculation of the sequence of events. Safe and reliable data regarding valve construction and operation can be obtained by using series programs (SRV 200 and SRV 350 trials).

38945 (INIS-mf—10624, pp 61-82) **Fluid-structure interactions of reactor core and fuel rods in case of loss of coolant accidents.** Schumann, U. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Projekt Nukleare Sicherheit). 1980. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752240. (CONF-800386—Pt.2).

From Annual meeting on nuclear technology; Berlin, F.R. Germany (25 Mar 1980).

With the assistance of homogenization methods, it is possible to set up an equivalent homogeneous model for the heterogeneous mixture of fuel rods and water. This model can be seen as a continuum and be treated with the methods available for such. In place of scalar material dimensions, as - for example - the density, tensorial dimensions will be applied. As the first result of this, it was established that only 43% of the mass of the reactor core is effectively involved in the horizontal motion of the core jacket at blowdown. The FLUX computer calculation program is to be further developed by means of the addition of a homogenized reactor model, by consideration of the flexibility of the reactor pressure vessels and

by connection of the intact circuit nozzles in order to provide a realistic determination of the stresses occurring in loss of coolant accidents.

38946 **(INIS-mf—10650) Phenomenological vessel burst investigations. Final report of phase I.** Hippelein, K.W.; Julisch, P.; Muz, J.; Schiedermaier, J. (Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Jul 1985. 561p. (In German). NTIS, PC E99; Available from NTIS as TIB/B87-08191.

Fourteen burst experiments have been carried out using vessels with circumferential and longitudinal flaws, for investigation of the fracture behaviour, i.e. the time-related fracture opening. The vessels had dimensions (outer diameter x wall thickness = 800 x 47 mm) which correspond to the dimensions of the main coolant piping of a 1300 MW/sub e/ PWR. The test specimens had been made of the base-safe material 20 MnMoNi 55 and of a special, 22 NiMoCr 37 base alloy. The experimental conditions with regard to pressure and temperature have been chosen so as to correspond to normal operating conditions of a PWR (p proportional to 17.5 MPa, T proportional to 300/sup 0/C), i.e. the flaws have been so dimensioned that failure was to be expected at a pressure of p proportional to 17.5 MPa. As a rule, water has been used as the pressure medium, or in some cases air, in order to influence the time-dependent pressure decrease. Fluid and structural dynamics calculations have also been made. In order to determine the impact of a fast propagating crack on the leak-to-fracture curve, which normally is defined by quasistationary experiments, suitable tests have been made with large-volume, cylindrical vessels (outer diameter x wall thickness x length = 3000 x 21 x 14000 mm) made of the material WSt E 43. The leak-before-fracture criterion has been confirmed.

38947 **(INIS-mf—10689) Finding instrument errors in nuclear power stations using a Luenberg observer.** El Madbouly, E.E. (Duisburg Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Elektrotechnik). 6 Sep 1983. 188p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-09987.

The work is concerned with finding instrument errors (IFD scheme) in nuclear power stations using one or more estimators (Luenberg observers), which require a mathematical model of the processes occurring in the nuclear power station, and a logic, which identifies the faulty measuring equipment from the estimates (analytical or software redundancy). As the direct estimated error of an observer does not only react to errors of measurement, but also to system errors, 4 processes are developed here, which are more or less insensitive to changes of system parameters. These are: the robust observer scheme, the methods of the difference in estimated error of two reduced observers or two observers in full order and the parameter invariant observer scheme. Using this IFD process, instrument errors in a PWR and a BWR could be clearly identified.

38948 **(JAERI-M—86-111) Development of the technique and systems for the emergency monitoring and prediction calculation.** (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 121p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702515.

This report contains papers on emergency research carried out under Subcommittee for the Monitoring and Prediction of Radionuclides Accidentally Released to the Atmosphere organized by JAERI from 1980 through 1985. According to subjects ten papers are classified into three groups; 1) development of emergency monitoring technique for radiations and radionuclides; 2) research on protection effects of Japanese houses for radiations and radioactivity; 3) development of emergency prediction calculation systems and verification of the calculation models. The research program was accomplished with much success, and some of the developed technique and systems are going to be put on practical use. The research was aided by many people from many organizations.

38949 **(JAERI-M—86-135) Study of transient burnout under flow reduction condition.** Iwamura, Takamichi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 102p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702530.

Transient burnout characteristics of a fuel rod under a rapid flow reduction condition of a light water reactor were experimentally and analytically studied. The test sections were uniformly heated vertical tube and annulus with the heated length of 800 mm. Test pressures ranged 0.5 — 3.9 MPa, heat fluxes 2160 — 3860 KW/m^2, and flow reduction rates 0.44 — 770 %/s. The local flow condition during flow reduction transients were calculated with a separate flow model. The two-fluid/three-field thermal-hydraulic code, COBRA/TRAC, was also used to investigate the liquid film behavior on the heated surface. The major results obtained in the present study are as follows: The onset of burnout under a rapid flow reduction condition was caused by a liquid film dryout on the heated surface. With increasing flow reduction rate beyond a threshold, the burnout mass velocity at the inlet became lower than the steady-state burnout mass velocity. This is explained by the fact that the vapor flow rate continues to increase due to the delay of boiling boundary movement and the resultant high vapor velocity sustains the liquid film flow after the inlet flow rate reaches the steady-state burnout flow rate. The ratio of inlet burnout mass velocities between flow reduction transient and steady-state became smaller with increasing system pressure because of the lower vapor velocity due to the lower vapor specific volume. Flow reduction burnout occurred when the outlet quality agreed with the steady-state burnout quality within 10%, suggesting that the local condition burnout model can be used for flow reduction transients. Based on this model, a method to predict the time to burnout under a flow reduction condition in a uniformly heated tube was developed. The calculated times to burnout agreed well with some experimental results obtained by the author, Cumo et al., and Moxon et al.

38950 (KFK—4170, pp 1-21) **On the course of the reactor accident at Chernobyl and on its transferability to German nuclear plants.** Hennies, H.H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Geschaeftsfuehrung). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The RBMK reactor is so different from the BWR's and PWR's operating in Germany that the individual design characteristics and potential causes of accidents cannot be compared directly. It is worth noting the difficult control characteristics of the Russian type with the positive void coefficient and the absence of a pressure-proof safety containment. The plant which suffered the accident is briefly described.

38951 (KFK—4170, pp 23-29) **Effects of the Chernobyl reactor accident - dose suffered by the population.** Kiefer, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Hauptabteilung Sicherheit). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

Measurements show that the main radiation load during the first few weeks occurred from I-131, but that in the long-term one must consider the ingestion of Cs-137 with food, while Sr-90 is of no significance. The inhalation dose has already reached its limit, but the external dose may rise by 1 mrem during 1986. Due to ingestion, an additional 2.5 mrem has been measured in children and 1 mrem effective equivalent dose in adults. The load on the population will vary in the range of natural radiation.

38952 (KFK—4170, pp 31-41) **Results from and prospects for reactor safety research and its support by the Federal Ministry of Research and Technology.** Lehr, G. (Bundesministerium fuer Forschung und Technologie, Bonn, Germany, F.R.). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The research and development work done so far has made a considerable contribution to exploring the safety factors of nuclear power stations and their systems and to developing safety techniques further. One should emphasize the work on quantifying the risks associated with the use of nuclear power, which pinpoint weaknesses in the safety concept. Future points for reactor safety research are still component safety, quality assurance, transient analysis, the course of accidents, man/machine interfaces, the analysis of weaknesses and reliability.

38953 (KFK—4170, pp 43-112) **Nuclear Safety Project 1972-1986 - aims and results.** Rininsland, H.; Kuczera, B. (Kernforschungszentrum Karlsruhe G.m.b.H., KfK, Germany, F.R. Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Projekt Nukleare Sicherheit). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The report contains four examples in compressed form from the working subjects of the dynamic stresses of reactor components, the behaviour of fuel elements in accidents, core melt-out accidents in LWR's and the retention, behaviour and effects of released radionuclides from nuclear power stations. Most of the PNS research projects are completed. The CORA program will be completed in the next 1 to 2 years.

38954 (KFK—4170, pp 113-137) **EDF's experience in PWR safety.** Tanguy, P. (Electricite de France, 75 - Paris). Aug 1986. NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

Some aspects related to the safety organization in France and the standardization policy are briefly presented. Experience with the safety of PWR's are reviewed. Two aspects for safety in operation were found to be essential. The plant's operators should be associated with the solution of the safety problems during the construction, as part as basic knowledge acquisition and the utility should be a full partner in a data collection and analysis system.

38955 (KFK—4170, pp 139-162) **Current perspectives on nuclear power plant risks and the use of risk-based information in regulation.** Ross, D.; Ernst, M.; Murphy, J. (Nuclear Regulatory Commission, Washington, DC, USA). Aug 1986. NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

A major research effort has been underway by the NCR to develop an improved understanding of severe accidents and to provide a technical basis to support regulatory decisions. A product of this severe accident research program is a reassessment of the source term technology, issued as draft NUREG-documents. The analytical methodology, the uncertainties and sensitivities, peer review, preliminary insights, new capabilities, and regulatory uses are shortly discussed.

38956 (KFK—4170, pp 163-175) **Fuel element behaviour in accident conditions. Introduction to the research program of the PNS.** Fiege, A. Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The relevant phenomena, such as can deformation and ability to cool, oxidation and embrittlement of Zircaloy cans and the interaction between the can and the fuel can be understood and described quantitatively in the whole temperature range between normal operation and core melt-out. The PNS investigations referred to the understanding of the relevant failure mechanisms of LWR fuel rods and the preparation of experimentally verified computer models for realistic accident analyses. The determination of the extent of the damage in the reactor core, the examination of the damage due to fission product release and the quantifying of safety factors were of special importance.

38957 (KFK—4170, pp 177-200) **Can deformation and core emergency cooling for a loss of coolant accident in a pressurized water reactor.** Erbacher, F.J. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorbauelemente). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The most important results on fuel rod and fuel element behaviour in the refilling and flooding phase of a loss of coolant accident are summarized. The out-of-pile and in-pile experiments are orientated towards the design data of the core emergency cooling systems and the fuel elements for PWR's of Kraftwerk Union. The Zircaloy-4 cans used were cold formed and stress relieved by annealing. The number of burst cans and the circumferential burst expansion can be determined sufficiently and the ability to cool to a cooling channel blockage of about 90% can be maintained.

38958 (KFK—4170, pp 201-250) **High temperature oxidation of Zircaloy cladding tubes in steam.** Leistikow, S. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Material- und Festkoerperforschung). Aug 1986. (In German, English). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The high temperature oxidation of Zircaloy-4 of LWR fuel in steam was investigated under loss-of-coolant (LOCA) and severe fuel damage (SFD) conditions of a PWR. Typical PWR tubings were exposed at 600-1600/sup 0/C to flowing steam, steam/argon and steam/hydrogen mixtures under isothermal and temperature-transient conditions. This range comprises the α-β-Zr phase transformation and changes of the oxidation product ZrO/sub 2/ from monoclinic to tetragonal and cubic structure (creep deformation).

38959 (KFK—4170, pp 251-319) **Investigations of severe core damage, particularly the chemical interactions between the fuel and can material.** Hofmann, P.; Hagen, S. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H., KfK, Germany, F.R. Hauptabteilung Ingenieurtechnik). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The results of the single effect laboratory investigations, UO/sub 2//Zircaloy interactions and dissolving of UO/sub 2/ by molten Zircaloy, and the single rod and bundle experiments, which were previously done in the NIELS test rig, are described. Some information is given on the CORA test rig. The experiments show a comprehensive and detailed understanding of the material behaviour of the different bundle and core components at temperatures above 1200/sup 0/C. Apart from oxidation of the can in steam, the chemical reactions between the cans and the fuel in the preliminary field before core melt-out can be described quantitatively.

38960 (KFK—4170, pp 321-346) **Description of fuel rod behaviour and the extent of damage in the core with the SSYST program system.** Meyder, R. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorentwicklung). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

A rough survey of the SSYST program system is supplemented by the explanation of the models for the deformation behaviour of Zircaloy, the individual rod analysis and the analysis of the extent of damage in the core. The SSYST system makes it possible to check the experiments in the KfK and to estimate the consequences of an accident of a LOCA.

38961 (KFK—4170, pp 347-365) **Course of core meltdown accidents: Fission product release, source terms and Chernobyl emission.** Albrecht, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Radiochemie). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The presumed course of a core melt-out accident in a PWR is sketched. There is a survey of the most important results on fission product release, which were obtained by experiments on the SASCHA melt test rig. The questions on determining the fission release source terms in the environment are dealt with and some considerations are made of radioactivity release in the Chernobyl reactor.

38962 (KFK—4170, pp 367-379) **Significance of chemical reactions between reactor materials under core melting conditions.** Skokan, A.; Holleck, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Material- und Festkoerperforschung). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The chemical reactions between materials in the course of a LWR core melting accident have effects on the chemical composition of the components and molten phases as well as on their properties. The oxide melt starts as a UO/sub 2/-ZrO/sub 2/ melt. The elements of the metal melt are oxidized in the sequence Zr-Cr-Fe and are then intermixed with the oxide melt which is diluted by intermixing with oxidized steel constituents and molten concrete. The fission products are heterogeneously dissolved in the oxide melt. The vaporization of some fission products depends on the oxygen potential and on the chemical reactions of the melt.

38963 (KFK—4170, pp 381-398) **Experiments for the verification of the NAUA code.** Schoeck, W.; Bunz, H.; Koyro, M. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik, LAF). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The retention ability of the safety containment for aerosol type fission products plays a decisive part in the calculation of the radiological source term for hypothetical accidents in LWR's. The models in NAUA and the overall concept were confirmed by experimental investigations of individual effects (condensation, diffusion, phoretic separation) and of the integral aerosol behaviour in realistic conditions (DEMONA test program).

38964 (KFK—4170, pp 399-408) **Application of the NAUA code for the analysis of the aerosol behaviour in LWR containments in core meltdown accidents.** Bunz, H.; Schoeck, W.; Koyro, M. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik, LAF). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The load on the environment of the power station due to aerosol type radioactivity after an assumed core melt-out accident can be simulated with all the boundary conditions by means of the NAUA code. The calculations done with the code and the associated iodine behaviour code IMPAIR show a considerable reduction of the effects even for release category FK2. The most important numerical results for aerosols and for iodine for the low pressure case are summarized.

38965 (KFK—4170, pp 409-430) **Beta experiments for verifying the WECHSL code. Experimental results on melt-concrete interactions.** Alsmeyer, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorbauelemente). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The work done on a melt-concrete interaction is marked by agreed, mutually complementary experimental and theoretical investigations. After phenomenological experiments, the individual questions are more deeply examined in laboratory experiments. Models built on the basis of special experiments permitted the construction and early application of computer programs. With the progressive development of computer programs, the necessity arose of verifying them by BETA experiments. The by now completed program development made it possible to give information on the core melt-out accident.

38966 (KFK—4170, pp 431-453) **Verification of the WECHSL code for melt-concrete interaction and application to the core melt-out accident.** Reimann, M. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorbauelemente). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

Design calculations for the BETA plant were done with a version of the WECHSL code, where the heat flow densities transmitted to the concrete during the whole course of an accident are reproduced by suitably defined individual experiments. The use of the WECHSL code refers to a core melt-out accident which is initiated by a leak in the primary circuit and subsequent failure of the emergency core cooling and in which on switching over to sump operation, after melting of the reactor pressure vessel, the melt pours into the shielding pit in a standard German PWR.

38967 (KFK—4170, pp 455-481) **Main points of further development of accident sequence model UFOMOD and first analyses of the Chernobyl reactor accident.** Ehrhardt, J.; Panitz, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The computer models and sets of data contained in the accident sequence model UFOMOD of DRS-B make it possible to describe the important transport processes in the environment up to human beings, the administrative and medical protection and countermeasures and the effects of exposure to radiation on human organisms. In this context, first analyses are made of processes outside the Chernobyl reactor.

38968 (KFK—4170, pp 501-523) **Behaviour of a PWR safety containment with rising internal pressure load.** Krieg, R.; Goeller, B.; Messemer, G.; Wolf, E. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Reaktorentwicklung). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

For the PWR Philippsburg (KKP II) a slowly increasing containment pressure typical for a core melt accident is assumed. The failure pressure and failure mode of the containment are determined using the ROTMEM code. It turns out that the sealing box covering the bolted connection at the equipment hatch will fail at a containment overpressure between 12.9 and 13.7 bar. Then the leakage through the bolted connection is sufficient to prevent further pressure increase. However, if the sealing box failed at a somewhat higher pressure, a global containment failure with extreme mechanical damage would have to be expected.

38969 **(KFK—4170) Concluding colloquium of the Nuclear Safety Project (PNS). Proceedings.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Aug 1986. 592p. (In German). (CONF-8606303—). NTIS, PC E99; Available from NTIS as TIB/B87-06320.

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The main points of the report are: environmental loads due to nuclear power stations and fuel reprocessing plants, behaviour of the system during reactor faults, extent of damage for the largest hypothetical reactor accidents and its dependence on time, assessment of the consequences of large hypothetical accidents and safety-related assessment of nuclear plants. The contributions relate particularly to the dynamic stresses on reactor components, behaviour of fuel elements in accidents, core melt-down accidents in LWR's and retention, behaviour and effects of released radionuclides from nuclear plants. Up-dating contributions concern the course, the effects and the analysis of the Chernobyl reactor accident. One contribution each is concerned with the development of waste air filters, the soil/plant transfer of actinides and the description of an FDWR.

38970 **(KTA-GS—51) KTA status report II/1986.** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). Dec 1986. 61p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08679.

The status report II/86 gives an account of the KTA activities and achievements in the regulatory sector in the period between the 39th and 40th KTA meeting (June 11 to November 25, 1986). The survey of rules and codes approved of has been elaborated in cooperation with the chairmen of the working groups and sub-committees. The report is intended to provide quick information on developments in the nuclear regulatory system. Information on regulatory work in progress is given in the KTA manual, indicating changes e.g. in subject fields, technical details, time-schedules, or members of working groups.

38971 **(KURRI-TR—278) Records of radiation control division, No.21 (1984).** Fukui, Masami (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1986. 63p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702535.

This report is a summary of activities of the radiation control division on the safety management in the fiscal year, 1984. This report describes the radiation control based on the records of Indoor Radiation Control Section, Field Radiation Control Section and Personal Radiation Control Section, which contain continuous monitoring of external radiation doses both inside and outside of the working area, of radioactive concentrations in dust and air in the radiation controlled area and outside of the KUR facilities, personal control on the radiation exposure, maintenance of devices for radiation monitoring and the inspection.

38972 **(NUREG—0940-Vol.6-No.1) Enforcement actions: Significant actions resolved: Quarterly progress report, January-March 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement). Jun 1987. 333p. NTIS, PC A15/MF A01 - GPO. File Number TI87900814.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (January-March 1987) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

38973 **(NUREG—1211) Regulatory analysis for resolution of Unresolved Safety Issue A-46, seismic qualification of equipment in operating plants.** Chang, T.Y.; Anderson, N.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight). Feb 1987. 70p. NTIS, PC A04/MF A01 - GPO. File Number TI87900529.

The margin of safety provided in existing nuclear power plant equipment to resist seismically induced loads and perform required safety functions may vary considerably, because of significant changes in design criteria and methods for the seismic qualification of equipment over the years. Therefore, the seismic qualification of equipment in operating plants must be reassessed to determine whether requalification is necessary. The objective of technical studies performed under Task Action Plan A-46 was to establish an explicit set of guidelines and acceptance criteria to judge the adequacy of equipment under seismic loading at all operating plants, in lieu of requiring these plants to meet the criteria that are applied to new plants. This report presents the regulatory analysis for Unresolved Safety Issue (USI) A-46. It includes: Statement of the Problem; the Objective of USI A-46; a Summary of A-46 Tasks; a Proposed Implementation Procedure; a Value-Impact Analysis; Application of the Backfit Rule; 10 CFR 50.109; Implementation; and Operating Plants To Be Reviewed to USI A-46 Requirements.

38974 **(NUREG—1269) Loss of residual heat removal system: Diablo Canyon, Unit 2, April 10, 1987.** (Nuclear Regulatory Commission, Walnut Creek, CA (USA). Region V). Jun 1987. 105p. NTIS, PC A06/MF A01 - GPO. File Number TI87900823.

This report presents the findings of an NRC Augmented Inspection Team (AIT) investigation into the circumstances associated with the loss of residual heat removal (RHR) system capability for a period of approximately one and one-half hours at the Diablo Canyon, Unit 2 reactor facility on April 10, 1987. This event occurred while the Diablo Canyon, Unit 2, a pressurized water reactor, was shutdown with the reactor coolant system (RCS) water level drained to approximately mid-level of the hot leg piping. The reactor containment building equipment hatch was removed at the time of the event, and plant personnel were in the process of removing the primary side manways to gain access into the steam generator channel head areas. Thus, two fission product barriers were breached throughout the event. The RCS temperature increased from approximately 87°F to bulk boiling conditions without RCS temperature indication available to the plant operators. The RCS was subsequently pressurized to approximately 7 to 10 psig. The NRC AIT members concluded that the Diablo Canyon, Unit 2 plant was, at the time of the event, in a condition not previously analyzed by the NRC staff. The AIT findings from this event appear significant and generic to other pressurized water reactor facilities licensed by the NRC.

38975 **(NUREG/CR—2331-Vol.6-No.2) Safety research programs sponsored by Office of Nuclear Regulatory Research: Quarterly progress report, April 1-June 30, 1986.** Bari, R.A.; Bezler, P.; Boccio, J.L.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Hall, R.E.; Hofmayer, C.H.; Khatib-Rahbar, H.; Luckes, W.J. Jr. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Nov 1986. Contract AC02-76CH00016. 105p. (BNL-NUREG—51454-Vol.6-No.2). NTIS, PC A06/MF A01 - GPO. File Number TI87005050.

This progress report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the Division of Accident Evaluation, Division of Engineering Technology, and Division of Risk Analysis and Operations of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. The projects reported are the following: High Temperature Reactor Research, SSC Code Improvements, Thermal-Hydraulic Reactor Safety Experiments, Thermodynamic Core-Concrete Interaction Experiments and Analysis, Plant Analyzer, Code Assessment and Application, Code Maintenance (RAMONA-3B), MELCOR Verification and Benchmarking, Source Term Code Package Verification and Benchmarking, Uncertainty Analysis of the Source Term; Stress Corrosion Cracking of PWR Steam Generator Tubing, Soil-Structure Interaction Evaluation and Structural Benchmarks, Identification of Age Related Failure Modes; Application of HRA/PRA Results to Support Resolution of Generic Safety Issues Involving Human Performance, Protective Action Decisionmaking, Rebaseling of Risk for Zion, Containment Performance Design Objective, and Operational Safety Reliability Research.

38976 **(NUREG/CR—4527-1) An experimental investigation of internally ignited fires in nuclear power plant control cabinets: Part 1: Cabinet effects tests.** Chavez, J.M. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Apr 1987. Contract AC04-76DP00789. 119p. (SAND—86-0336). NTIS, PC A06/MF A01. File Number TI87010751.

A series of full-scale cabinet fire tests was conducted by Sandia National Laboratories for the US Nuclear Regulatory Commission. The cabinet fire tests were prompted by the potential threat to the safety of a nuclear power plant by a cabinet fire in either the control room or in a switchgear type room. The purpose of these cabinet fire tests was to characterize the development and effects of internally ignited cabinet fires as a function of several parameters believed to most influence the burning process. A primary goal of this test program was to test representative and credible configurations and materials. This series of 22 cabinet fire tests demonstrated that fires in either benchboard or vertical cabinets with either IEEE-383 qualified cable or unqualified cable can be ignited and propagate. However, fires with IEEE-383 qualified cable do not propagate as rapidly nor to the extent that unqualified cable does. Furthermore, the results showed that the thermal environment in the test enclosure and adjacent cabinets is not severe enough to result in autoignition of other combustibles; although in some of the larger fires melting of plastic materials may occur. Smoke accumulation in the room appeared to be the most significant problem, as smoke obscured the view in the enclosure within minutes after ignition. Essentially, a cabinet fire can propagate within a single cabinet; however, for the conditions tested it does not appear that the fire poses a threat outside the burning cabinet except the resulting smoke.

38977 **(NUREG/CR—4815) Demonstration testing of a surveillance robot at Browns Ferry Nuclear Plant: Analysis of costs and benefits.** White, J.R.; Farnstrom, K.A.; Harvey, H.W.; Howard, R.; Feltman, A.; Llewellyn, P. (Remote Technology Corp., Oak Ridge, TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Mar 1987. 76p. NTIS, PC A05/MF A01 - GPO. File Number TI87900591.

This report presents the results of an NRC project to determine whether robotics equipment can be cost effective in performing surveillance and inspection work at existing nuclear power plants. A mobile surveillance robot, called SURBOT, was developed by the Remote Technology Corporation (REMOTEC) to perform visual, sound, and radiation surveillance within rooms designated as radiologically hazardous. SURBOT was tested in the turbine building of the Browns Ferry Nuclear Plant (BFNP) by TVA personnel for a five-month period. The results showed that SURBOT obtains higher quality data and can perform more thorough surveillance within radiation areas than workers wearing protective clothing. SURBOT can be transferred between rooms without releasing contamination in the hallways using a portable enclosure. TVA has estimated that over 100 person-rem exposure and $100,000 operating costs can be saved annually at the BFNP using SURBOT for surveillance in 54 turbine and reactor building rooms. TVA recommendations for improving the function, reliability, and maintainability have been incorporated into a production model of SURBOT which is now commercially available from REMOTEC along with other types of mobile robots and manipulators.

38978 **(NUREG/CR—4819-Vol.1) Aging and service wear of solenoid-operated valves used in safety systems of nuclear power plants: Volume 1, Operating experience and failure identification.** Bacanskas, V.P.; Roberts, G.C.; Toman, G.J. (Franklin Research Center, Philadelphia, PA (USA); Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Mar 1987. Contract AC05-84OR21400. 66p. (ORNL/Sub—83-28915/4/V1). NTIS, PC A04/MF A01 - GPO. File Number TI87007688.

An assessment of the types and uses of solenoid-operated valves (SOVs) in nuclear power plant safety-related service is provided. Through a description of each SOV's operation, combined with knowledge of nuclear power plant applications and operational occurrences, the significant stressors responsible for degradation of SOV performance are identified. A review of actual operating experience (failure data) leads to identification of potential nondestructive in-situ testing which, if properly developed, could provide the methodology for degradation monitoring of SOVs. Recommendations are provided for continuation of the study into the test methodology development phase.

38979 **(NUREG/CR—4876) Silver-indium-cadmium control rod behavior and aerosol formation in severe reactor accidents.** Petti, D.A. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). Apr 1987. Contract AC07-76ID01570. 132p. (EGG—2501). NTIS, PC E06/MF A01 - GPO. File Number TI87010661.

Includes 2 sheets of 48x reduction microfiche.

Silver-indium-cadmium (Ag-In-Cd) control rod behavior and aerosol formation in severe reactor accidents are examined in an attempt to improve the methodology used to estimate reactor accident source terms. Control rod behavior in both in-pile and out-of-pile experiments is reviewed. A mechanistic model named VAPOR is developed that calculates the downward relocation and simultaneous vaporization behavior of the Ag-In-Cd alloy expected after control rod failure in a severe reactor accident. VAPOR is used to predict the release of silver, indium, and cadmium vapors expected in the Power Burst Facility (PBF) Severe Fuel Damage (SFD) 1-4 experiment. In addition, a sensitivity study is performed. Although cadmium is found to be the most volatile constituent of the alloy, all of the calculations predict that the rapid relocation of the alloy down to cooler portions of the core results in a small release for all three control rod alloy vapors. Potential aerosol formation mechanisms in a severe reactor accident are reviewed. Specifically, models for homogeneous, ion-induced, and heterogeneous nucleation are investigated. These models are applied to silver, cadmium, and CsI to examine the nucleation behavior of these three potential aerosol sources in a severe reactor accident and to illustrate the competition among these mechanisms for vapor depletion. The results indicate that aerosol formation in a severe reactor accident occurs in three stages. In the first stage, ion-induced nucleation causes aerosol generation. During the second stage, ion-induced and heterogeneous nucleation operates as competing pathways for gas-to-particle conversion until sufficient aerosol surface area is generated. In the third stage, ion-induced nucleation ceases; and heterogeneous nucleation becomes the dominant mechanism of gas-to-particle conversion until equilibrium is reached.

38980 **(NUREG/CR—4899) Component Fragility Research Program: Phase 1 component prioritization.** Holman, G.S.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract W-7405-ENG-48. 173p. (UCID—21003). NTIS, PC A08/MF A01 - GPO. File Number TI87008495.

Current probabilistic risk assessment (PRA) methods for nuclear power plants utilize seismic "fragilities" - probabilities of failure conditioned on the severity of seismic input motion - that are based largely on limited test data and on engineering judgment. Under the NRC Component Fragility Research Program (CFRP), the Lawrence Livermore National Laboratory (LLNL) has developed and demonstrated procedures for using test data to derive probabilistic fragility descriptions for mechanical and electrical components. As part of its CFRP activities, LLNL systematically identified and categorized components influencing plant safety in order to identify "candidate" components for future NRC testing. Plant systems relevant to safety were first identified; within each system components were then ranked according to their importance to overall system function and their anticipated seismic capacity. Highest priority for future testing was assigned to those "very important" components having "low" seismic capacity. This report describes the LLNL prioritization effort, which also included application of "high-level" qualification data as an alternate means of developing probabilistic fragility descriptions for PRA applications.

38981 **(NUREG/CR—4904) Investigation of steel containment buckling from dynamic loads.** Butler, T.A.; Baker, W.E.; Babcock, C.D. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). May 1987. Contract W-7405-ENG-36. 50p. (LA—10985-MS). NTIS, PC A03/MF A01 - GPO. File Number TI87010787.

Buckling of free-standing nuclear steel containment buildings from dynamic base excitation was investigated in a combined experimental/numerical program. A polycarbonate scale model of a containment building was excited with scaled earthquake transients and single-frequency harmonic transients to determine the peak base acceleration levels required to induce buckling. Buckling was identified using recorded signals from strain gages and accelerometers, high-speed video records, and audibility (heard by the human ear). Experimental results are compared to numerical results obtained using a freezing-in-time technique. Results indicate that, depending on the criterion used, predictions of when buckling occurs can range from conservative to unconservative. It was also found that excitation of higher shell harmonics may influence the buckling capacity of containments. Results of this study are considered preliminary in that additional tests need to be performed using models fabricated from steel rather than from polycarbonate.

38982 (OEFZS—4383, pp 15-23) **Radiation burden in Austria from the Chernobyl reactor accident.** Pichlmayer, F. Feb 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702400. (LA—172/87; AR—26/87; ST—143/87).

In Seibersdorf scientists give answers to questions in connection with the Chernobyl reactor accident.

An overview of the radioactivity levels in Austria after the Chernobyl accident, in air, grass, milk and different meats as a function of time. A table of the Austrian legal activity uptake limits, for ^{290}Sr, ^{131}I, ^{134}Cs, ^{137}Cs, ^{103}Ru and ^{106}Ru provide standards of comparison. For 1986 the integral burden for the population is estimated to be 30 mrem.

38983 **(ORNL/TM—1168/R2-1/87) Revision of HFIR [High Flux Isotope Reactor] operating procedures.** McGinty, D.M. (Oak Ridge National Lab., TN (USA)). 23 Jan 1987. Contract AC05-84OR21400. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87005584.

This report documents modifications to the facility and changes in some operating procedures for the High Flux Isotope Reactor (HFIR). The topics covered include: Reactor Operation, Reactor Start-up, Reactor Safety Systems, Reactor Control Systems, Reporting Requirements, and Administrative Procedures. (FI)

38984 **(RISO-M—2623) Method for consequence calculations for servere accidents. 0.1% release from Barsebaeck (in accordance with SSI).** Nielsen, F. (Risoe National Lab., Roskilde (Denmark)). Jan 1987. 42p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751930.

With the exception of the part about collective doses, this report was commissioned by the Swedish State Power Board. The part about collective doses was commissioned by the Swedish National Institute of Radiation Protection. The report contains a calculation of radiation doses in the sursurroundings caused by a theoretical core meltdown accident at one of the Barsebaeck reactors with filtered venting through the FILTRA plant. The calculations were made by means of the PLUCON4 code. The assumption used for the calculations were givon by the Swedish National Institute of Radiation Protection as follows: Pasquill D with wind speed 3 m/s and a mixing layer at 300 m height. Elevation of the release: 100 m with no energy release. The release starts 12 hours after shut-down and its duration is one hour. The release contains 100% of the noble gasses and 0.1% of all other isotopes in a 1800 MW/ sub t/-reactor.

38985 **(RKS—86-10) Nuclear power news No. 38. Extra issue about the Chernobyl accident.** (Nuclear Safety Board of Swedish Utilities, Stockholm). 12 Jun 1986. 18p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751966.

The following matters are treated: What happened at the Chernobyl accident? The Russian graphite reactor - a comparison with light water reactors. The Soviet program for nuclear power. Serious organizational unsatisfactory state of things at the nuclear power plants of Soviet. Graphite reactors of the nuclear power program of the world. The radioactive fallout in Sweden after Chernobyl. The risks involved in radioactive radiation - an experts conception.

38986 **(RKS—86-12) Nuclear power news No. 39. Extra issue on account of the Chernobyl accident.** (Nuclear Safety Board of Swedish Utilities, Stockholm). 25 Jul 1986. 15p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751967.

The following matters are discussed: Swedish reactors made safe against hydrogen explosions. 'Rust-rot' no ageing problem for Ringhals-1. No risk of a short life span for the reactor tank of Oskarshamn-1. Strontium and plutonium make small contributions to the radiation doses after Chernobyl. The union of hospital physicists say that the public has been conveyed wrong concept of risks. Opinions about the safety of the plant of Barsebaeck.

38987 **(RKS—86-16) Accident of Chernobylsk-4 reactor and its consequences.** (Nuclear Safety Board of Swedish Utilities, Stockholm). 15 Oct 1986. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751968.

This report deals with the particulars of the accident as communicated by the Soviet delegation at an IAEA meeting by the and of August 1986. It was stated that the consequences emanated from the inherent instability of the design of the reactor, the deviation from the safety rules by the operators and the lack of a sight reactor containment. (G.B.).

38988 **(RKS—86-20) Nuclear power news No. 40. Evaluating Barsebaeck - Questions after Chernobyl etc. .** (Nuclear Safety Board of Swedish Utilities, Stockholm). 10 Nov 1986. 14p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751969.

The following matters are dealt with: Independent international evaluation of the safety of Barsebaeck renders high rating. What did the Russians reporting on the Chernobyl accident teach us? There is no risk with xenon poisoning in Swedish reactors. Could a reactor explode as an atomic bomb? The decommissioning plan of the centre party is wrong about the Swedish reactor safety. OECD: safe final disposal of nuclear power waste is possible.

38989 **(SAND—86-1648C) Analytical predictions for the performance of a reinforced concrete containment model subject to overpressurization.** Weatherby, J.R.; Clauss, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870812—4). NTIS, PC A02. File Number DE87006120.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Under the sponsorship of the US Nuclear Regulatory Commission, Sandia National Laboratories is investigating methods for predicting the structural performance of nuclear reactor containment buildings under hypothesized severe accident conditions. As part of this program, a 1/6th-scale reinforced concrete containment model will be pressurized to failure in early 1987. Data generated by the test will be compared to analytical predictions of the structural response in order to assess the accuracy and reliability of the analytical techniques. As part of the pretest analysis effort, Sandia has conducted a number of analyses of the containment structure using the ABAQUS general purpose finite element code. This paper describes results from a nonlinear axisymmetric shell analysis as well as the material models and failure criteria used in conjunction with the analysis.

38990 **(SAND—86-1676C) Plans and preparation for the destructive testing of a reinforced-concrete containment model.** Horschel, D.S.; Lambert, L.D. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 7p. (CONF-870812—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006130.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The US Nuclear Regulatory Commission is sponsoring several programs that address the response of nuclear reactor containments to hypothesized severe accidents. Under a program conducted at Sandia National Laboratories (Sandia), scale models of nuclear containments are pressurized in steps with nitrogen gas until excessive leakage or structural failure occurs. The objective of the containment model testing is to generate data that can be used to qualify methods for reliably predicting the response of LWR containments to overpressurization. The latest effort of this series of experiments is the pressure testing of a 1:6-scale LWR containment model made of reinforced concrete, which will be tested to failure in early 1987. The instrumentation that will be used during the test as well as the plans for conducting the test are described herein.

38991 **(SAND—87-0608C) Hydrogen in water-cooled nuclear reactors.** Jankowski, M.W.; Cummings, J.C.; Torgerson, D.F. (Sandia National Labs., Albuquerque, NM (USA); International Atomic Energy Agency, Vienna (Austria); Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1987. Contract AC04-76DP00789. 22p. (CONF-8706132—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010780.

From Annual CNA/CNS conference; St. John, Canada (15 Jun 1987).

This paper summarizes a report that reviews the knowledge of hydrogen-related phenomena considered in the safety assessment of a nuclear power plant having water-cooled nuclear reactors. This involves reviewing experimental results from research programs worldwide, describing analytical methods developed to provide tools for safety assessment, evaluating engineering features for controlling the hydrogen, and formulating certain conclusions and recommendations. This paper does not, however, address any regulatory and/or licensing requirements.

38992 **(SSI—85-07) Decommissioning and decontrolling the R1-reactor.** Bergman, C.; Holmberg, B.T. (National Inst. of Radiation Protection, Stockholm (Sweden)). 1 Feb 1985. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751950.

Sweden's first nuclear reactor - the research reactor R1 - situated in bedrock under the Royal Technical Institute of Stockholm, has in the period 1981-1983 been subject to a complete decommissioning. The National Institute for Radiation Protection has followed the work in detail, and has after the completion of the decommissioning performed measurements of radioactivity on site. The report gives an account of the work the Institute has done in preparation for- and during decommissioning and specifically report on the measurements for classification of the local as free for non-nuclear use.

38993 **(SSI—86-21) Consequences in Sweden of the Chernobyl accident.** Snihs, J.O. (National Inst. of Radiation Protection, Stockholm (Sweden)). 30 Sep 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751949.

It summarizes the consequences in Sweden of the Chernobyl accident, describes the emergency response, the basis for decisions and countermeasures, the measurement strategies, the activity levels and doses and countermeasures and action levels used. Past and remaining problems are discussed and the major investigations and improvements are given.

38994 **(SSI—86-25) Fallout in Sweden from Chernobyl. Part II.** Kjelle, P.E. (National Inst. of Radiation Protection, Stockholm (Sweden)). 12 Dec 1986. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751970.

This report supplements the first part representing registered gamma measurements during 1985 and the major part of 1986. The recording has been performed at 20 stations. A graphic comparison is made between the years 1985 and 1986.

38995 **(STEV—1986-R18) Risks of disaster in the energy system. After Chernobyl.** Kristoferson, L.; Kjellstroem, B.; Svenningsson, P.J. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 77p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751960.

The perception of environmental effects and risks is discussed concerning the difficulties to making objective comparisons between different energy sources. Risks may influence the choice of strategies of the replacement of nuclear electric power in the Swedish energy system. Risks for major accidents and disasters to occur at a small level of probability are presented concerning the existing or future energy sources. The choice of strategies is discussed by means of calculated examples.

38996 **Two phase fluid dynamic models with applications to nuclear reactor safety.** Travis, J.R. (Los Alamos National Lab., NM). pp 3.45-3.59 of Proceedings of second international topical meeting on nuclear power plant thermal hydraulics and operations. Wakabayashi, J.; Nariai, H. (eds.). Tokyo, Japan; Atomic Energy Society of Japan (1986). (CONF-860454—).

From 2. international topical meeting on nuclear power plant thermal hydraulics and operations; Tokyo, Japan (15 Apr 1986).

The ideas of the two-field (6 equation model) and drift-flux (4 equation model) description of two-phase flows are presented. Several example calculations relating to reactor safety are discussed and comparisons of the numerical results and experimental data are shown to be in good agreement.

38997 **Comparison of TRAC-PF1/MOD1 to a no-failure UPI test in the cylindrical core test facility.** Cappiello, M.W.; Spore, J.W. (Los Alamos National Lab., NM). pp 2.98-2.103 of Proceedings of second international topical meeting on nuclear power plant thermal hydraulics and operations. Wakabayashi, J.; Nariai, H. (eds.). Tokyo, Japan; Atomic Energy Society of Japan (1986). (CONF-860454—).

From 2. international topical meeting on nuclear power plant thermal hydraulics and operations; Tokyo, Japan (15 Apr 1986).

TRAC-PF1/MOD1 is compared to a no-failure upper plenum injection reflood test in the Cylindrical Core Test Facility. The results show that TRAC can accurately predict the asymmetric channeling of fluid from upper plenum into the core and that a multidimensional modeling capability is required to do so. The rod temperature behavior is accurately predicted for both the peak cladding temperature and the quench time in the high- and low-power zones. Excessive downflow of liquid at the tie plate is predicted as a result of the interfacial drag model used in TRAC.

25 ENERGY STORAGE

2506 Thermal

38998 **(BMFT-ET—5275-A) Model experiment and detailed investigations for a non-pressurized long-term heat store. Stage 1.** (EAB Energie-Anlagen Berlin G.m.b.H. (Germany, F.R.); Berliner Kraft- und Licht (BEWAG)-A.G. (Germany, F.R.); Technische Univ. Berlin (Germany, F.R.). fuer Baukonstruktion und Festigkeit; Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft). Nov 1981. 209p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87770141.

This is a report on the results of experimental material investigations on the storage basin cladding and on calculations of temperatures and heat losses when operating a non-pressurized long term heat store. The economy is also analyzed.

38999 **(CONF-870804—7) Optimization and analysis of LiH thermal energy storage device configurations for space power applications.** Siman-Tov, M.; Williams, P.; Olszewski, M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010404.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Thermal energy storage (TES) can be used to reduce the area and mass of the heat rejection system for space-based sprint power systems. During the sprint mode power cycle, reject heat is placed into storage. The heat is then rejected to the ultimate sink over the much longer non-operational portion of the orbits, through a correspondingly smaller radiator. Preliminary analysis has shown significant weight advantage for the heat storage plus radiator concept over the radiator only concept. Thermal performance analysis and optimization of five heat sink TES configurations using LiH was completed. The configurations are: (a) LiH encapsulated spheres in the packed bed, (b) standard tube and shell arrangement with LiH on the tube side, (c) tube and shell with LiH on the shell side, (d) alternating concentric rings of LiH and heat transport fluid, and (e) parallel slabs of LiH. System performance was calculated for a wide range of parameters and included effects of prespecified internal voids, enhanced conductivity and internal fins.

39000 **(LA-UR—87-1623) Integrated heat pipe-thermal storage system performance evaluation.** Keddy, E.; Sena, J.T.; Merrigan, M. (Los Alamos National Lab., NM (USA); Sundstrand Corp., Rockford, IL (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870804—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010118.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Performance verification tests of an integrated heat pipe-thermal energy storage system have been conducted. This system is being developed as a part of an Organic Rankine Cycle-Solar Dynamic Power System (ORC-SDPS) receiver for future space stations. The integrated system consists of potassium heat pipe elements that incorporate thermal energy storage (TES) canisters within the vapor space along with an organic fluid (toluene) heater tube used as the condenser region of the heat pipe. During the insolation period of the earth orbit, solar energy is delivered to the surface of the heat pipe elements of the ORC-SDPS receiver and is internally transferred by the potassium vapor for use and storage. Part of the thermal energy is delivered to the heater tube and the balance is stored in the TES units. During the eclipse period of the orbit, the stored energy in the TES units is transferred by the potassium vapor to the toluene heater tube. A developmental heat pipe element was fabricated that employs axial arteries and a distribution wick connecting the wicked TES units and the heater to the solar insolation surface of the heat pipe. Tests were conducted to verify the heat pipe operation and to evaluate the heat pipe/TES units/heater tube operation by interfacing the heater unit to a heat exchanger.

2509 Batteries

REFER ALSO TO CITATION(S) 39328

39001 **(AD-A—179820/6/XAB) Thin-film solid-state cells with three inorganic components. Final report, 31 September 1986-31 March 1987.** Gourdine, M.C. (Energy Innovations, Inc., Houston, TX (USA)). 30 Apr 1987. 65p. NTIS, PC A04/MF A01.

Thin-film solid-state electrochemical cells with inorganic components were investigated. Various combinations of materials and fabrication techniques were studied and classified to determine which had the better chance for commercialization. Theoretical predictions were verified by experiments, and provide a sound basis for predicting promising combinations. These thermovoltaic cells are divided into two main categories; large cells that are maintained at a high operating temperature by joule heat; and small- or medium-size cells that operate close to room temp. in a humid environment. Within these categories, there are primary and secondary type cells that offer distinct advantages over commercially available cells in both performance and price. High specific power (100 watt/lb.) and specific energy (1000 watt-hr/lb) are achieved by eliminating weight of chemical oxidizers, massive electrodes, and enclosures used in conventional batteries.

39002 **(AD-A—179925/3/XAB) Studies of the fundamentals of solid-state batteries. Final report.** Abraham, K.M.; Alamgir, M.; Perrotti, S.J. (EIC Labs., Inc., Norwood, MA (USA)). 5 Apr 1987. 53p. NTIS, PC A04/MF A01.

Studies of lithium/titanium sulfide cells utilizing polybis(methoxyethoxyethoxide) phosphazene) (MEEP) based polymer electrolytes have demonstrated the excellent potential of this inorganic polymer electrolyte for use in solid-state rechargeable Li batteries of applications at or near room temperature. A major drawback of the MEEP electrolyte has been its lack of dimensional stability, manifested in its tendency to flow. This flow property prevented the preparation of thin-film solid electrolytes. A solution to this problem was found in this program by blending MEEP with poly(ethylene oxide), PEO, which resulted in novel mixed polymer electrolytes exhibiting superior mechanical stability and high conductivity. The authors also developed a technique to fabricate solid-state cells with the pure MEEP electrolyte by supporting it on a thin, porous matrix comprising a fiberglass separator.

39003 **(NP—7770129) Transport qualities of non-aqueous electrolyte solution for high-energy batteries with lithium as anode.** Kindler, M. (Regensburg Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet 4 - Chemie und Pharmazie). 5 Aug 1985. 256p. (In German). NTIS (US Sales Only), PC A12. File Number DE87770129.

In this dissertation, conductivity and viscosity experiments are carried out on non-aquaeous electrolyte solutions over a wide range of concentrations and temperatures, in order to obtain information on the optimum configuration of the battery electrolyte in lithium high energy cells. γ-butyrolacton was used as the solvent which, because of its physical constants, has a much more favourable conductivity behaviour of lithium salts compared with propylene carbonate, a standard solvent in lithium batteries. A suitable purification process was developed and an exact analysis of γ-butyrolacton was made. The conducting salts used included compounds which were compatible with the lithium electrode: LiBF/sub 4/, LiClO/sub 4/, LiPF/sub 6/, LiAs F/sub 6/, LiSb F/sub 6/ and LiB Ph/sub 4/.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 39059

39004 **(EEO-ED—17/69) Automatic lighting control employing reset switches in a multi-storey office block. Demonstration at Jacob's Well, civic offices of the City of Bradford Metropolitan Council. Final report.** (Department of Energy, London (UK). Energy Efficiency Office; Building Research Establishment, Watford (UK)). Jan 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752803.

The results of two years of post-installation monitoring of automatic lighting control systems in a local authority office are presented as part of the UK Energy Efficiency Demonstration Scheme. The system included automatic re-set switches and allows automatic, central off-switching. Installation and commissioning were straightforward and after some experimentation, a single, central lunchtime switch-off was adopted. The simple payback period was 0.8 year.

39005 **(EEO-ED—111-64) Automatic remote monitoring and control of coal-fired boiler plant in schools. A demonstration in Staffordshire County Council schools. Final report.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Department of Energy, London (UK). Energy Efficiency Office). Jan 1987. 58p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752799.

Staffordshire County Council (SCC) has reduced coal consumption in 21 of its schools by an average of 12.9%. These reductions, achieved through the installation of automatic boiler control, have resulted in savings of over Pound 41,000/year. Following an initial pilot scheme in three schools, SCC installed a Transmitton Micropower 2000 Series system in 21 schools. Intelligent outstations in each school are connected to a single central station at the council offices in Stafford using the public telephone network. This allows boiler plant and heating systems to be monitored and controlled from Stafford, including operational control of boiler plant, day-to-day programming and monitoring of plant status and fault conditions. The project has proved that monitoring and control of coal-fired installations can be successfully achieved by a distributed energy management system with increased savings over conventional controls.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 39032, 39111, 39112

39006 **(IIUG-rep—85-12) Municipal responses to the energy challenge: Nysted, Denmark. Innovation and retreat in a rural municipality.** Woodward, A.E. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1985. 60p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87770169.

This case study is one of a series describing the social and organizational processes behind municipal innovation in energy planning, conservation and supply. Nysted in Denmark provides an example of both the potential and the limitations on innovation in energy in a small-town environment. The community sponsored an innovative planning project which has since become a model for Danish community energy inventory studies and planning. Further, many individuals in Nysted adapted their heating or electrical supply systems for the use of renewable fuels, especially wind and straw. The community relied on outside expertise and was confronted with the classic problem of transition and implementation when the consultants left. Nysted amply illustrates the dilemma of small communities faced with modern technological problems and limited technological resources.

39007 **(LA—10988-MS) The energy situation in five Central American countries.** Trocki, L.; Booth, S.R.; Umana Q, A. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 367p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87012708.

This study describes the energy resources and the changes that have taken place in energy supply and demand in five Central American countries between 1970 and 1984. Economic changes are also reviewed because they influence and are affected by changes in the energy sector. The work was performed under the auspices of the US Agency for International Development. The Central American countries of Costa Rica, El Salvador, Guatemala, Honduras, and Panama are highly dependent on fuel wood as a source of energy, particularly in the residential sector. They also rely upon imported oil products to supply a growing modern sector. Most countries have significant hydroelectric and geothermal resources, and most countries produce a large portion of their electricity from hydroelectric projects. Demand for electricity has grown rapidly. Relative shares of primary versus secondary energy in the five countries vary significantly and strongly correlate with average per capita income. Consumption of secondary energy has declined during the recent economic recession suffered by the region.

39008 **(PNL-SA—14967) Energy data needs for policy analysis.** Roop, J.M.; McNutt, B.; Podolak, M. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 18p. (CONF-870564—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011986.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

The first subsection offers some definitions, the second a brief general discussion of data requirements for policy analysis. Then we move to an analytical study that characterized the type of information that is useful for policy analysis: a study of structural change in the US economy over the period 1972 to 1977. This study is useful background information because structural changes can be attributed to the changes over time of decisions or choices of different economic agents: consumers, businesses, governments and the rest of the world. The method is illustrated by an examination of changes in labor requirements and changes in energy use in the US over the period 1972 to 1977. The third section refocuses this idea of structural change to examine the effect of minorities on energy use in the residential sector. The final section moves back to the general with some suggestions on the layering of data sources and how multiple data sets may be used to shed additional information on minority impacts.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 38566, 38651, 38657, 38698, 38702, 39044, 39112, 39113, 39114, 39115, 39117, 39118

39009 **(CONF-870564—2) National patterns of energy demand and expenditures by Hispanics.** Poyer, D.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011434.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

This paper is based on ongoing research, at Argonne National Laboratory, being done for the Office of Minority Economic Impact (MI) of the US Department of Energy. Under its legislative mandate MI is required to assess the impact of government policy, programs, and actions on US minorities. In line with this mission Argonne is currently involved in characterizing and analyzing the patterns of energy demand and expenditures of minorities. A major barrier associated with this task is the availability of sufficient data. With the possible exception of blacks, analysis of the patterns of energy demand for most minority population categories is all but impossible because of small sample sizes. The major source of residential energy consumption data, the Residential Energy Consumption Survey, only collects data on 5000 to 7000 households. For many minority population categories, this number of observations make any meaningful statistical analysis at least at the regional Census level practically impossible, with any further refinement of the analysis becoming even more difficult. In this paper our primary purpose is to describe the patterns of energy demand for Hispanics and nonhispanics but ancillary to that briefly present one possible solution to the data availability problem.

39010 **(DOE/ER—0323) Nuclear engineering enrollments and degrees, 1986.** (Oak Ridge Associated Universities, Inc., TN (USA)). May 1987. Contract AC05-76OR00033. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012452.

The 1986 nuclear engineering survey universe was 61 academic institutions that reported students enrolled or receiving degrees. The survey covers undergraduate, master's, and doctoral enrollments and degrees, employment or postgraduation plans of nuclear engineering graduates, and the percentage of nuclear engineering degrees granted to foreign nations during the period 1980-1986. (DWL)

39011 **(DOE/ER—0324) Health physics/radiation protection enrollments and degrees, 1986.** (Oak Ridge Associated Universities, Inc., TN (USA)). May 1987. Contract AC05-76OR00033. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012453.

The 1986 health physics/radiation protection survey universe was 60 academic institutions. Statistics gathered in the survey include total enrollments, degrees awarded, employment or postgraduation plans, foreign national enrollments, women and minority enrollments, and regional distributions for both undergraduate and graduate level degree programs. 5 figs. (DWL)

39012 **Management of energy technology, 1987.** Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). 107p. (CONF-870210—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This book presents the papers given at a conference on energy-source technology. Topics considered at the conference included solar thermal central receiver power, wind/diesel hybrid systems, power system reliability, US nuclear waste disposal programs, waste fuels, waste heat recovery systems, technology transfer, the disposal of hazardous wastes, the socio-economic impacts of high-level nuclear waste facility siting, and developing a national system for transporting high-level nuclear waste.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 38490, 38537, 38551, 38616, 38619, 38667, 39058, 39602, 39603, 39604, 39615, 39617, 39631, 39632

39013 **(KFK-PEF—13) Development of technical and economical strategies for emission reduction measures for sulphur dioxide and nitrogen oxides from stationary sources in Baden-Wuerttemberg.** Rentz, O.; Haasis, H.D.; Morgenstern, T.; Remmers, J.; Sautter, T.; Schons, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1987. 403p. (In German). NTIS (US Sales Only), PC A18/MF A01. File Number DE87770248.

Within this project strategies for reducing emissions of sulphur dioxide and nitrogen oxides from stationary sources in Baden-Wuerttemberg are developed. For these strategies, possible shifts of the optimal energy supply and industrial structure are determined and analysed. The strategies are based on the real energy supply and industrial structure of Baden-Wuerttemberg and by this, on the possible technical measures for emission reduction. For solving the conflict between energy conversion and emission reduction an optimizing energy-environmental-model is used. With 144 figs., 69 tabs., 316 refs.

39014 **(NP—7752610) Research and scientific services in the environmental sector in Switzerland. Report and suggestions from the viewpoint of the Federal Government.** (Bundesamt fuer Umweltschutz, Bern (Switzerland)). Apr 1985. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752610.

This is an overview on matters related to environmental research and environmental services in Switzerland as far as they are maintained with Federal funds. In formulating a sober and systematic environmental policy, the following items are dealt with: methods, surveys, problem analysis, aims, instruments and measures, and implementation. Different possibilities are discussed of how to take research requirements more fully into account. In so doing, a distinction is made between measures in the sector of the Federal Government, the universities, private enterprise, and the international sector.

39015 **(PNL-SA—14640) Economic effects of reduced growth in eastern forests upon the forest products industry of the Pacific Northwest.** Darwin, R.F.; Callaway, J.M.; Nesse, R.J. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 5p. (CONF-8705154—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012165.

From 21. Pacific Northwest Regional Economic conference; Seattle, WA, USA (1 May 1987).

Several studies have reported both localized and region-wide decreases in the radial growth rates of several commercially important tree species in the northeast and southeast regions of the United States. These observed reductions in tree growth rates may be related to increases in acid deposition and other man-made pollutants over the past three decades. This presentation focuses on how sensitive softwood product markets in the Pacific Northwest may be to forest productivity reductions in the eastern US. The magnitude of the potential impacts illustrates the level of volatility that economists and planners seeking to restructure the Pacific Northwest's economy face.

39016 **(SAND—86-2515) Emergency Management Information System Technologies.** Chapek, J.F.; Desonier, L.M.; Luetters, F.O.; Snell, M.K. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011579.

Computer-based workstations are being developed for crisis management use in Department of Energy Emergency Operations Centers. This report describes the technologies investigated, components selected for development, and capabilities being demonstrated for improved handling of crisis information. The technologies are being developed with simple user-friendly interfaces as stand-alone systems to meet specific needs, and they are expandable to integrated systems with specific capabilities and advantages for crisis management not available from off-the-shelf hardware and software.

39017 **(SAND—87-7106C) Methods for probabilistic assessments of geologic hazards.** Mann, C.J. (Illinois Univ., Urbana (USA). Dept. of Geology; Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-8704137—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011721.

From MGUS '87; Redwood City, CA, USA (13 Apr 1987).

Although risk analysis today is considered to include three separate aspects: (1) identifying sources of risk, (2) estimating probabilities quantitatively, and (3) evaluating consequences of risk, here, only estimation of probabilities for natural geologic events, processes, and phenomena is addressed. Ideally, evaluation of potential future hazards includes an objective determination of probabilities that has been derived from past occurrences of identical events or components contributing to complex processes or phenomena. In practice, however, data which would permit objective estimation of those probabilities of interest may not be adequate, or may not even exist. Another problem that arises normally, regardless of the extent of data, is that risk assessments involve estimating extreme values. Rarely are extreme values accurately predictable even when an empirical frequency distribution is established well by data. In the absence of objective methods for estimating probabilities of natural events or processes, subjective probabilities for the hazard must be established through Bayesian methods, expert opinion, or Delphi methods. Uncertainty of every probability determination must be stated for each component of an event, process, or phenomenon. These uncertainties also must be propagated through the quantitative analysis so that a realistic estimate of total uncertainty can be associated with each final probability estimate for a geologic hazard.

2904 Natural Resources

39018 **(PB—87-185054/XAB) National water summary 1983--hydrologic events and issues.** (Geological Survey, Reston, VA (USA). Water Resources Div.). 1984. 253p. (USGS-WSP—2250). NTIS, PC A12/MF A01.

See also PB—87-185062; Color illustrations reproduced in black and white.

The national summary reviews current hydrologic conditions and recent events in the United States and provides a broad overview of the hydrologic issues facing the Nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the western Pacific Islands under the jurisdiction of the United States. Major issues described include: (1) the short-term vulnerability of surface-water supplies and shallow ground-water supplies to drought; (2) concerns about the reliability of water supplies as competition for water increases; (3) declining ground-water levels; (4) control of surface-water pollution, especially nonpoint sources of pollution; (5) contamination of ground-water supplies and the mitigation of existing sources of pollution, such as hazardous-waste sites; (6) the potential effects of acidic precipitation; (7) chronic problems of flooding; (8) the impacts of resource development, such as coal mining and low-head hydropower, on water resources; (9) the development of water allocation and reallocation procedures.

39019 **(PB—87-185062/XAB) National water summary 1984--hydrologic events, selected water-quality trends, and ground-water resources.** (Geological Survey, Reston, VA (USA). Water Resources Div.). 1985. 478p. (USGS-WSP—2275). NTIS, PC A21/MF A01.

See also PB—87-185054; Color illustrations reproduced in black and white.

The first part of the second National Summary provides a synopsis of the hydrologic conditions and water-related events that occurred during the 1984 water year (October 1, 1983-September 30, 1984). Streamflow variations are compared to precipitation, temperature, and upper-air atmospheric pressure for the four seasonal quarters of the year to relate surface-water flows to climatic conditions. The second part contains two sections. In the section titled Water-Quality Issues, the occurrence of sediment, dissolved solids, nutrients, and pesticides in the Nation's streams are discussed. The occurrence and sources of nitrate in ground water also are discussed. The third part, summarizes for each State, and all U.S. territorial and trust possessions, the distribution, characteristics, and uses of principal aquifers.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 39012, 39445, 39561, 40220

39020 **(AD-A—179842/0/XAB) Technology transfer - its implications for DOD (Department of Defense). Student report.** Wang, T.N. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1987. 46p. (ACSC—87-2645). NTIS, PC A03/MF A01.

This paper addresses the transfer of Western technology to the Soviet Union. By understanding the Soviets' efforts, organization, and methods to acquire Western technology, the reader can appreciate the significance of the technology-transfer problem--especially to the military. The paper also addresses current US controls to counter the exit of technology and concludes with recommendations that could further stem the flow of Western technology to the Soviet Union.

39021 **(LA—10881-PR) Los Alamos National Laboratory technology transfer report, FY 1985: Progress report.** Sadler, M.A.; Tellier, N.A.; Freese, K.B. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012700.

This report summarizes Los Alamos' interactions in FY85 with US industry, universities, and state and local governments. The benefits of these collaborative efforts are mutual. While the Laboratory is able to provide access to valuable technology, expertise, and unique facilities, the Laboratory also strengthens its technical base, expands its programmatic perspective, enlarges the community of participants in ongoing programs, and forms valuable partnerships for mutual professional development among our staffs.

39022 **(NP—7770202) Environmental engineering. Current R + D projects 1986. As of August 1, 1986.** (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Bonn (Germany, F.R.). Projekttraegarschaft Umweltschsutztechnik). 1986. 325p. (In German). NTIS (US Sales Only), PC A14. File Number DE87770202.

The publication contains summaries of 62 research projects in the fields 'Low-emission industrial processes' and 'Treatment of solid and gaseous wastes from industrial processes'.

39023 **Technology transfer: A case study of successful project management.** Armoni, Y.J.; Kossik, G.; Peavy, J. (Walk, Haydel and Associates, New Orleans, LA). pp 67-74 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

How do you transfer developmental technology from its inventors to a third party (the engineers) who will develop a design for the production of the new technological product? Furthermore, how do you transfer the design technology across the Atlantic for Europeans to build? Finally, how do you transfer the technology from the inventors to the operators? This paper is a case study of how these transfers were successfully accomplished.

39024 **Accounting/budgeting/costing dimensionally evaluated: A framework for management information.** Friesen, E.N. (Los Angeles Dept. of Water and Power, Los Angeles, CA). pp 55-66 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Modern accounting practice tends to confuse or ignore the subtle but significant difference between the object of expenditure and the resources required to achieve it. In some cases a third element may be intertwined with these two, that of the organization performing the function. The organizational unit may be considered as a resource, a cost, or a profit center, and sometimes all of these at once. While these considerations may be of some usefulness to management in terms of control, incentives, and measurement any fuzziness tends to blur the fundamental differences between the resources used, the function(s) performed, and the organization unit. When these differences are obscure the Accounting/Budgeting/Cost control process becomes difficult to understand and use effectively.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 38567, 38619, 38845, 38847

39025 **(KFK—4186) Conflicting opinions: The controversy accompanying the site selection for a German reactor facility (1950-1955). A study of the foundation and history of the Karlsruhe Nuclear Research Center and of some historical aspects of the German nuclear energy sector.** Gleitsmann, R.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Stuttgart Univ. (Germany, F.R.)). Dec 1986. 288p. (In German). NTIS, PC E17; Available from NTIS as TIB/B87-08659.

The foundation and history of the Karlsruhe Nuclear Research Center (KfK) partly reflects the history of nuclear energy and the historical development of the German technology sector which in particular with respect to its topical implications (e.g. the acceptance of advanced technologies) is unfortunately still being underestimated in most cases. Studying the historical development of an institution such as Kfk reveals regional ties, municipal, dis-

trict, neighbourhood and industrial ties which are normally buried and veiled. The history of its foundation and development bears evidence of the fact that Kfk is an integral part of the Karlsruhe technology region. The period from 1952 to 1955 was characterized by vehement disputes preceding the final site selection for the first nuclear reactor facility of the Federal Republic of Germany. Each endeavouring to be selected th competitors, i.e. the Free State of Bavaria represented by the city of Munich and the newly established Southwestern Baden-Wuerttemberg represented by the city of Karlsruhe virtually vied with one another for the most attractive proposals and bids. They were both fully aware of the fact that a positive decision would mean to assume obligations in the order of magnitude of enormous million sums. The slightest chance of being chosen the very region to house the promising and hopeful 'nuclear energy industry' of the Federal Republic of Germany evidently required rather high bids on both sides.

39026 (NUREG—0936-Vol.5-No.4) NRC Regulatory Agenda: Quarterly report, October-December 1986. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). May 1987. 151p. NTIS, PC A08/MF A01 - GPO. File Number TI87900763.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period and includes copies of letters, notices, and orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions and the licensee's responses. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, in the interest of promoting public health and safety as well as common defense and security.

2908 Waste Heat Utilization

39027 (NP—7770139) Optimization of the interplay between district heating and customer's heating systems. Final report. Brachetti, H.E.; Jung, C.; Manthey, W.; Westhoff, H. (Fernwaerme-Forschungsinstitut in Hannover e.V., Hemmingen (Germany, F.R.); Stadtwerke Hannover A.G. (Germany, F.R.)). Jun 1985. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770139.

From the analysis of existing heating systems, an easy to use and low-cost measuring technique should be developed, which would make it possible to determine the operating conditions of a heating system in a short time. Moreover simple methods should be found for an operation under the condition of maximum temperature spreading. The temperatures of finned and plate type heating elements of a heating system, build in the 70's were measured by the means of contact thermometers and infrared radiation thermometers. As indicated by the results, most of the examined heating elements did not show the designated temperature distribution. This was caused by several thermo-hydraulic mixing phenomena of reflux water with initial water, as well as zones of dead water, turbulence and so on. Therefore the amount of transferred heat was reduced. The results showed, that the quantities of water, related to the specific heating circuits were usually too high. Operation with maximum spreading will be achieved, when every heating element is passed by the required amount of water. It had been realized that the speed controled circulation pump was the cheapest method to reach maximum spreading. To measure actual conditions an infrared radiation thermometer was developed, which yields information about the temperature distribution of a heating element in a few seconds. An immediate determination of mass flow rates at every optional point of a piping system was realized by the means of a small vane water meter. In addition to findings about the operation mode of existing heating systems, the project led to the development of a transportable measuring device, consisting of independent components like: infrared radiation thermometer, small vane water meter, data acquisition unit, microcomputer.

39028 Integration of engineering systems. Harhalakis, G.; Bohse, M.E. (Systems Research Center, Univ. of Maryland, College Park, MD). pp 1-6 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Systems integration is recognized as a key to improving efficiency and productivity in an engineering and manufacturing environment. The ultimate goal is to provide engineering management with improved systems efficiency, control, and monitoring capabilities, and to allow for consistent, accurate, and real-time sharing of data between related functions which now rely on manual procedures for communication between standalone applications. Because of the technical and organizational issues involved, systems integration will occur in a gradual, modular fashion, and will require considerable management effort and support. The proposed starting point for this process is the integration of Manufacturing Resource Planning, (MRP II) and Computer Aided Design, (CAD). MRP II, being an engineering and manufacturing systems controller, will serve as the central coordinator of this and future integrated systems.

2910 Conservation

REFER ALSO TO CITATION(S) 39044, 39110, 39111, 39112, 39113, 39114, 39117, 39118, 39122

39029 (IIUG-rep—85-10) Energy conservation programmes for consumers. Report on a multinational study. Gaskell, G.; Joerges, B. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1985. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770168.

This report summarizes the activities and findings of a four-year, multi-national project into energy conservation policies and programmes. On the basis of extensive preliminary studies of the existing situation in the participating countries, empirical case studies of selected local energy conservation programmes were performed and analysed cross-nationally. These evaluation studies combined a 'top-down' policy analytic approach with a 'bottom-up' approach, the analysis of the consumer context and programme impacts. It is shown that local programs have a unique ability to achieve both energy conservation policy, and almost by implication environmental policy, and social policy objectives. Finally, recommendations for the implementation of energy conservation programmes at the local level and possible roles for the CEC in the stimulation of local programmes and in multi-national research are made.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 38544, 39007, 39112

39030 (NP—7752613) Energy conservation report. Report on measures for enhancing rational utilization of energy in Land-owned buildings. (Senator fuer Bau- und Wohnungswesen der Stadt Berlin (Germany, F.R.)). Apr 1985. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752613.

The measures taken by the Berlin administration in 1984, for rational and economical use of energy, resulted in annual savings of energy costs of about DM 12.2 million. The following measures, or groups of measures, contributed to this result: Energy saving building and plant retrofitting (energy conserving redevelopment programme); energy consumption monitoring (determination of standard consumption data); controlled utilisation of energy types (approvals required for use of energy types). These three groups of measures are explained, and details are given in tables and diagrams (in an annex). Information refers to thermal insulation, control and adjustment to demand, cost-benefit ratios, periods of amortization, and efficiency of the measures taken; and to the buildings supplied with heat (such as office buildings, schools, swimming pools, greenhouses), or to types of energy (oil, gas, solid fuel, district heat), as well as to heat recovery measures (flue gas, sewage water). (HWJ).

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 38616, 39040, 39110, 39111, 40100

39031 **(NP—7752235) State and development of energy supplies in Baden-Wuerttemberg.** Kuballa, S. (Stuttgart Univ. (Germany, F.R.). Geographisches Inst.). 1984. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752235.

There is a brief outline of the historical development of energy supplies in Baden-Wuerttemberg (formerly Baden and Wuerttemberg) where the energy carriers, electricity, petroleum, natural gas and nuclear energy are considered. The numerical data end with the year of the report, 1982.

39032 **(NP—7770150) Applied general equilibrium modelling for longterm energy policy in the Federal Republic of Germany.** Conrad, K.; Henseler-Unger, I. (Mannheim Univ. (Germany, F.R.). Inst. fuer Volkswirtschaftslehre und Statistik; Mannheim Univ. (Germany, F.R.). Sonderforschungsbereich 5 - Staatliche Allokationspolitik im Marktwirtschaftlichen System). 1984. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87770150.

The energy model is based on an extension of applied general equilibrium models of the Leontief's input-output type, first implemented by Hudson and Jorgenson. One objective of the project is to choose specifications of sectoral production and cost functions which permit to estimate the unknown parameters of the price functions and input demand functions from a single input-output table in 10 energy and 35 non-energy industries. The second objective is to determine the price for capital and labor as well as the components of final demand endogeneously instead of using a separate growth model as an engine of the economic development. The third objective is to combine the concept of price dependent substitution within the input structure with the concept of vintage coefficients for the latest plants. By this is incorporated into the input-output analysis the effect on growth as a result of investment, the effect on capacity as a result of new plants, and the effect on prices as a result of new technologies. An application of the model shows the longterm impact on growth and prices under alternative technologies in the electricity industry (nuclear or coal-fired power plants).

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 38442, 38494, 38502, 38505, 38505, 38533, 38537, 38544, 38551, 39031, 39031

39033 **(NP—7770148) Aggregate time series gasoline demand models. Review of the literature and new evidence for West Germany.** Blum, U.C.H.; Foos, G.; Gaudry, M.J.I. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Wirtschaftspolitik und Wirtschaftsforschung). Mar 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87770148.

In this article, we review and analyse recent studies on aggregate time series gasoline demand models, with an emphasis on the West German context. We relate the most important national and international publications in the area to categories which help to present and analyse results. We give special attention to results from Germany, notably to FOOS' (1986) extensive work using flexible functional forms.

39034 **(NP—7770210) Peruvian energy economy - an analysis with special regard to small-scale coal mining.** Diederich, F.; Spittler, E. (Technische Hoschschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Internationale Technische und Wirtschaftliche Zusammenarbeit). 1985. 114p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770210.

The study abstracted facilitates access to the present economic and natural resources situation of Peru. In recent years Peru, which is among the major mineral resources supplying countries, has seriously and repeatedly been affected by problems rooting in natural or economic circumstances. The tense economic situation was calling for the activation of all means and measured promising an improvement. Looking for solutions Peruvian coal which after the discovery of oil fields had been much neglected was rediscovered again. General information about Peruvian economy and policies is followed by a discussion of the structure and status of the energy and mining sectors. Part three is dedicated to concrete problems of the coal industry and possible future developments on the coal sector.

39035 **(OCS/MMS—87-0047) Oil and Gas Leasing/Production Program: Annual report, FY 1986.** (Minerals Management Service, Vienna, VA (USA). Office of Offshore Information and Publications). 31 Mar 1987. 50p. NTIS, PC A03/MF A01. File Number DE87900887.

Pursuant to section 15(1) of the Outer Continental Shelf Lands Act (OCSLA), as amended (43 USC 1343(1)), this annual report on the Outer Continental Shelf (OCS) Oil and Gas Leasing and Production Program for Fiscal Year (FY) 1986 is herewith submitted to the Congress of the United States. The document summarizes receipts and expenditures and, in compliance with section 22(g) of the Act, also includes information on OCS safety violations as reported by the US Coast Guard (USCG).

2960 Electric Power

REFER ALSO TO CITATION(S) 38616, 38651, 38795, 39016, 39112, 39113, 39114, 39118

39036 **(DOE/EIA—0191(86)) Cost and quality of fuels for electric utility plants, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 6 Jul 1987. 220p. NTIS, PC A10/MF A01 - GPO; 1; GPO Dep. File Number DE87012675.

Electric utilities received a record 687.0 million short tons of coal in 1986, surpassing the previous record of 684.1 million short tons set in 1984. Receipts of coal increased over 20 million short tons from 1985. Petroleum receipts were 228.5 barrels, up significantly from the 164.9 million barrels reported in 1985. A large decline in petroleum prices during the first seven months of 1986 (Table HL6) led to higher demand of No. 6 fuel oil by electric utilities. Gas receipts totaled 2,437.8 billion cubic feet (Bcf), a decrease of over 400.0 Bcf from 1985 totals. 7 figs., 61 tabs.

39037 **(DOE/EIA—0226(87/04)) Electric power monthly, April 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 21 Jul 1987. 46p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87012957.

In April 1987, net generation from petroleum-fired units was 7898 gigawatthours, the lowest level since November 1985 when petroleum-fired units produced 7008 gigawatthours of electricity. Net generation from petroleum was 14% lower in April 1987 than in April 1986. In contrast, petroleum-fired net generation was higher in all months of 1986 than in the corresponding months of 1985 with the exception of January, and reached a maximum change of more than 96% in July. Net generation from petroleum was higher in 1986 than in 1985 due to the decline in the delivered price of petroleum to electric utilities in the first quarter of 1986. The April 1987 level of petroleum-fired net generation reversed that trend. Net generation from petroleum represented 4.2% of the total electricity produced during April 1987. This is also the smallest monthly percentage share of total net generation from petroleum-fired units since November 1985. Net generation from gas-fired units reached a level of 19,595 gigawatthours in April 1987, 3.3% higher than in April 1986. This larger amount of electricity produced from gas-fired units was partially due to increased gas use by electric utilities in California of 22.5 billion cubic feet. California is the second-largest user of gas for electricity generation in the Nation. Texas is the largest. In April 1987, gas-fired net generation in California was 5121 gigawatthours, 92% more than in April 1986. California utilities also increased their use of petroleum in 1986 as did other utilities with petroleum capable units. However, since the price of petroleum has risen, gas is being substituted for

petroleum at California utilities, particularly at larger generating plants with gas/petroleum capability. 27 tabs.

39038 **(DOE/NBM—7008223) The Bonneville Partnership: A proposal.** (USDOE Bonneville Power Administration, Portland, OR). Jun 1987. 99p. NTIS, PC A05. File Number DE87008223.

Primary purpose is improved customer service, both for the electric utilities of the Pacific Northwest and for the region's consumers. The Bonneville Partnership proposal builds on the needs and concerns of electricity consumers, utility customers, and Bonneville. Consumers need a reliable and low-cost supply of electricity, as well as information that can help them make wise choices about their use of various sources of energy. Bonneville's customers have voiced concerns about their position in an increasingly competitive energy market. Over the past several months, Bonneville followed a careful process to arrive at the designs of the seven proposed programs: special rates for new and expanding industries, incentives for activating idle capacity, industrial technical assistance, commercial design assistance, incremental load program, incentives for wood heat displacement, and special rates to prevent business closure.

39039 **(EPRI-EM—5252) Market research on demand-side management programs: Preferences among commercial customers: Final report.** Farber, M.; George, S. (Temple, Barker and Sloane, Inc., Lexington, MA (USA); XENERGY, Inc., Oakland, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 119p. Reseach Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920452.

This project demonstrates the effective use of market research to design commercial sector demand-side management (DSM) programs that are responsive to the attitudes and preferences of customers. The primary research method for this project was a telephone survey of San Diego Gas and Electric and Bonneville Power Administration commercial sector customers, which gathered information in the areas of customer characteristics (e.g., size, type of business), attitudes about energy issues, and interest in five types of DSM programs. The five programs are: reduced interest loans for DSM measures, direct DSM investment by the utility, direct load controls, payments by utilities for energy savings, and guaranteed savings. A working hypothesis for this project was that different segments within the commercial sector would have different attitudes about DSM and thus would be interested in different types of utility DSM programs. The results indicate a strong relationship between customer attitude (e.g., "I wouldn't borrow money to pay for any energy saving equipment") and the type of DSM programs in which a customer is interested. However, there was little evidence of differences in attitude or program preference across various segments of the commercial sector. All customer categories gave highest ranking to guaranteed savings programs and relatively low rankings to direct load control programs. Beyond the empirical results of the surveys, this project demonstrates that relatively low-cost, quick-turnaround market research techniques can provide valuable information for the design and promotion of DSM programs. The project also reinforces the need for each utility to design DSM programs in response to customer preferences, rather than concentrate solely on its internal objectives. 7 figs.

39040 **(NP—7752611) Energy laws and energy economy.** Boerner, B. (Wibera Wirtschaftsberatung A.G., Duesseldorf (Germany, F.R.); Koeln Univ. (Germany, F.R.). Inst. fuer Energierecht). 1986. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752611.

Energy laws are among the factors determining the future-oriented behaviour and activities of energy economy. The paper abstracted takes a closer look at the power and influence of energy laws on the decisions of energy economy. Adequate decisions will be considering aspects of planning, i.e. the distribution of production plants, regional supplies, German electric utilities in Europe, as well as aspects of time, i.e. the realization and depreciation of investment. However, the actual final outcome may differ from the original intention in case sociological circumstances collide with the unchanged law or in case the laws are modified. (HSCH).

39041 **(STEV—1986-R16) Out of blind alloys. Study of electric power policy having efficient use as main strategy and on outline of an industry - compatible application. After Chernobyl.** Eriksson, O.; Mogren, A. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 98p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751958.

The report treats ideas and perspectives and its aim is to broaden the views. Thus it might be possible to make the choice between different futures. The roads and the mechanisms of choice are discussed. The existing technical-economical, system-theoretical investigations which characterize the energy policy are considered to have a limited scope.

39042 **Beyond management by objectives.** Friesen, E.N. (Los Angeles Dept. of Water and Power, Los Angeles, CA). pp 51-54 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Management of Objectives (MBO) has become popular again, but will be no more than a fad unless we consider the results actually achieved and make the rewards appropriate. To be effective, an entity must recognize that it is multidimensional and must consciously attempt to balance the components of each dimension. How well this balance is achieved is the effectiveness of the entity. This paper describes the components and dimensions of an individual or organization as an operating entity and proposes some suggestions for better management. Managerial effectiveness and efficiency are also defined.

39043 **Power systems reliability improvement benefits: A framework for analysis.** Slater, K.J. (Energy Management Associates, Inc., Atlanta, GA). pp 15-18 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Reliability methods are used extensively in the electric utility industry. They can be applied to all three main elements which contribute to the cost and quality of electric service; generation, transmission, and distribution. However, reliability improvements in these three areas are generally examined in isolation from improvements in the other areas. In this paper, the not uncommon concept of an "optimal generation reserve margin" is examined for its potential to include the transmission and the distribution elements of electric service. From the concept, a framework is developed for the analysis of reliability improvement in all three main elements of service.

39044 **Process evaluation as a management tool.** Keating, K.M.; Lerman, D.I. (Bonneville Power Administration (KES), P.O. Box 3621, Portland, OR 97208). pp 451-460 of Proceedings of the second great PG & E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—).

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

Program evaluation is usually seen as a quantified measurement of a program's impact and a judgment of a program's success in achieving its goals. However, a thorough impact evaluation includes important process aspects. These can clarify data anomalies and provide a basis for interpreting the reported impacts. A complete process evaluation can serve not only as an adjunct to an impact study, but as a valuable program management tool. Process evaluations are integral parts of most BPA program evaluations. In the case of small pilot projects, they are often the main evaluation tools. This paper illustrates their implementation and use at BPA, drawing on examples from the seven process studies completed in the last three years as well as from ongoing work.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 39115

39045 **(STEV—1986-R11) Consumption of electric power for space heating of residential buildings and other premises. After Chernobyl.** Sandberg, E.; Westerlund, R. (Statens Energiverk, Stockholm (Sweden)). Oct 1986. 122p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751953.

The analysis comprises power consumption to 1989 and to 1997 using different energy prices. The effects of oil prices on consumption has been calculated. The level of the consumption of electric power of the year 1989 is estimated to be 2-3 TWh higher than the level of 1997. This is because of not yet accomplished economizing measures and relatively new installations.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 38697, 38698, 38700, 38723

39046 **(TPG-OP—9) Renewable energy in the U.K.: anatomy of a government programme.** Flood, M. (Open Univ., Milton Keynes (UK). Technology Policy Group). Jan 1986. 69p. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A detailed review is given about how the UK's renewable energy programme was organized and run since its inception in 1974. The structure and responsibilities of both the Department of Energy and the Energy Technology Support Unit are identified. Chapters dealing with the development of the programme, management of the individual projects, political support and finance are presented. The final section deals with the conclusions.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

39047 **(CONF-870664—3) A review of ANL fouling program.** Chow, L.S.H.; Wang, C.S.; Swift, W.M.; Teats, F.G. (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011437.

From 25. symposium on engineering aspects of magnetohydrodynamics; Bethesda, MD, USA (24 Jun 1987).

Since 1980, Argonne National Laboratory (ANL) has been conducting experiments to investigate the fouling characteristics of seed-ash deposits formed on the convective surfaces in MHD steam plants. Before the experimental program began, it was postulated at ANL that the MHD deposits formed downstream of the radiant boiler will be solid or partially liquid, depending on the local gas temperature and the deposit thickness. This postulation was confirmed experimentally during the initial phase of the ANL fouling program. Further, these tests have identified the temperature regimes in which these different types of deposits would form. At gas temperatures below the melting point of the seed material (e.g., 1340 K if the seed is pure K_2SO_4), tube deposits were formed by the deposition of entrained solid particles of seed and ash and showed no tendency to density. At gas temperatures sufficiently above the seed melting point (e.g., above about 1600 K), tube deposits were formed by condensing seed vapor and ash particles. The outer surface of the growing seed-ash deposit layer reached the seed melting point. Under this condition, the depositing seed material flowed off the tubes as a liquid film without severely impairing heat transfer or gas flow. At gas temperatures ranging from about 1400 to 1600 K, tube deposits were formed by the deposition of solid ash particles and liquid seed particles and, occasionally, grew prohibitively thick. These deposits tended to be particularly hard and dense and were more difficult to remove. 10 refs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 39221, 39335

39048 **(DOE/MC/23265—2362) Corrosion of materials in Molten Carbonate Fuel Cells (MCFC): Quarterly technical status report, January 1, 1987-March 31, 1987.** Howes, M.A.H. (IIT Research Inst., Chicago, IL (USA)). Apr 1987. Contract AC21-86MC23265. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012086.

Objective is to determine and describe the hot corrosion mechanism in MCFC bipolar sheet materials and current collectors and to provide a corrosion model to predict hot corrosion behavior of metals and alloys in the fuel cell environment. Tasks to be performed in accomplishing the objective are (1) to determine the influence of electrolyte composition, amount of electrolyte, gas composition (including the presence of sulfur impurities), composition of the alloy, electrode potential and thermal cycling on the mechanisms of corrosion of bipolar sheet, and current collector materials, As part of the above, the morphological development of oxide scales and adherence of the scale to the substrate shall be determined; (2) to create a corrosion model based on the data obtained; and (3) to recommend bipolar sheet and current collector materials.

39049 **New catalysts and new electrolytes for acid fuel cells.** Ross, P.N.; Appleby, A.J. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California - Berkeley, Berkeley, CA 94720). pp 575-581 of Catalyst characterization science: Surface and solid state chemistry. Deviney, M.L.; Gland, J.L. Washington, DC; American Chemical Society (1985).

In the phosphoric acid fuel cell as currently practiced, a premium (hydrogen rich) hydrocarbon (e.g. methane) fuel is steam reformed to produce a hydrogen feedstock to the cell stack for direct (electro-chemical) conversion to electrical energy. At the fuel electrode, hydrogen ionization is accomplished by use of catalytic material (e.g. Pt, Pd, or Ru) to form solvated protons. At the cathode, air is reduced catalytically by reaction with solvated protons to generate the product water. In practical cells, the acid concentration is very high (>95%) and the solvated protonic species are not actually known, i.e. H/sub 3/O/sup +/ and H/sub 4/PO/sub 4//sup +/ but probably very little H/sub 9/O/sub 4//sup +/. In order to maximize waste heat utilization, the cell stack operating temperature has been increased to the maximum value tolerated by the materials in current use, which is presently about 200°C. Catalysis is the key to the commercial viability of fuel cells, particularly the air cathode catalysis, as much more polarization occurs at the cathode than at the anode. Because of the severe operating conditions of the cell stack, the choice of catalytic materials is extremely limited. At present, the emphasis in cathode materials research is to find catalysts that provide improved kinetics over the integrated lifetime of the cell stack (ca. 40,000 hrs.). The baseline cathode material is Pt supported on a graphitized carbon black, usually at a weight loading of 10%, and a crystallite size of ca. 3 +- 0.5 nm (i.e. about 30 percent exposed as measured by hydrogen chemisorption). At the end-of-life, we project that some Pt will be lost from the cathodes, and the crystallite size will have increased considerably, to 10-15 nm or more. The actual end-of-life conditions for the baseline catalyst are not known, since phosphoric acid fuel cell stacks have not yet been operated for the expected lifetime.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 39004, 39005, 39030

39050 **(AD-A—179821/4/XAB) Development of LITE - a graphic module for lighting analysis in the Computer-Aided Engineering and Architectural Design System (CAEADS). Final report.** Barton, C.K. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Mar 1987. 84p. (CERL-TR-E—87/02). NTIS, PC A05/MF A01.

This report documents the development and use of the graphic module LITE, a subsystem of the Computer-Aided Engineering and Architectural Design System (CAEADS). LITE was developed to assist U.S. Army Corps of Engineers (USACE) in-house lighting engineers in performing the required analysis during the concept design phase. The program can do Illuminating Engineering Society (IES) Zonal Cavity calculations internally and, in addition, can build a Conservation of Electric Lighting (CEL-1) input deck for comprehensive daylighting studies. Also described is the LCHG program which was developed to maintain the luminaire data base file used by LITE for illuminance calculations. The LCHG program relies on textual rather than graphic interaction with the user. The data base is independent of any other project and can store an unlimited number of luminaires. The program is written in FORTRAN 77 and uses Tektronix 4109, 4014, and 4113 terminals of graphic representations. It is to be field-tested on selected USACE District/Division Harris computers beginning in early FY87.

39051 **(CONF-870620—8) Effect of backfilling material on ground coil performance.** Mei, V.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011647.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting; Nashville, TN, USA (28 Jun 1987).

Ground-coupled heat pump (GCHP) systems use the ground as low-grade solar energy storage medium. Their high potential for energy conservation has long been recognized. However, the effect of ground coil backfilling material has never been seriously analyzed for GCHP applications. For the northern part of the US where winter heating load dominates, variation in backfilling material can probably be ignored, because the soil adjacent to the ground coil (and any void) will be saturated for winter operation. It is not economically viable to add thermal backfill for relatively mild and short summer operation. For those areas where the summer cooling load dominates, the choice of a backfilling material becomes very important for the following reasons: (1) to minimize the contact resistance between coil and soil and (2) to maintain high thermal conductivity in the backfilling region even under very dry ground conditions. Both reasons involve moisture migration during ground coil summer heat rejection. This paper presents a mathematical model to describe the operation of horizontal ground coils, which includes the effect of backfilling material. The model was validated with field experimental data, with overall error between calculated and measured total energy exchange between coil and ground of only 4.4%, with the former on the conservative side. Three different backfilling materials were analyzed: clay, sand, and a fluidized mixture used for underground cable backfilling. The calculated results indicated that backfilling material made a big difference in coil performance. The fluidized mixture dissipates 47% more heat than the clay and 23% more than the sand. This model can be used to assess the effect of different kinds of backfilling materials. Improvements in coil performance versus cost of backfilling material can now be more realistically analyzed.

39052 **(CONF-870620—9) The simulation and performance of a centrifugal chiller.** Jackson, W.L.; Chen, F.C.; Hwang, B.C. (Oak Ridge National Lab., TN (USA); David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA). Power Systems Div.). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A02. File Number DE87012251.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting; Nashville, TN, USA (28 Jun 1987).

A computer simulation model was developed to analyze the performance of a water-cooled centrifugal chiller. The model is based on a heat pump thermodynamic cycle and empirical correlations for the performance of the system components. The system simulated is composed of a variable-speed centrifugal compressor with a hot-gas bypass option for capacity control, two shell-and-tube heat exchangers, and an expansion device. The model was validated and calibrated against the experimental test results of a 125-ton chiller. The performance of a similar chiller system at various operating conditions and design modifications was analyzed. System performance comparisons were made between a baseline case, cases with high-performance heat exchanger tubes and compressor motor, and various variable-speed compressor operating strategies. It was found that significant performance improvement can be realized by using variable-speed drive and on-demand control strategy.

39053 **(CONF-870811—1) Comparison concepts for analysis of metered energy use in commercial buildings.** MacDonald, M.; Akbari, H. (Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010602.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

An approach is presented for comparing commercial buildings when analyzing the energy performance of different buildings. The approach is in the conceptual stage, and research is needed to understand its potential benefits and uses. The approach includes 3 levels of characteristics information for buildings. Level 1 is the physical characteristics related to the building scheduling for occupancy and temperature, the energy systems in the building, and the envelope. Level 2 includes the addition of the monthly power densities for the total of all fuels to the level 1 data, which provides additional definition of building energy performance. Level 3 includes the addition of hourly power profiles for different daytypes (e.g., working and nonworking) to the level 2 data to provide additional detail. Research projects are needed to determine what level of detail is necessary for different types of analyses. The study of commercial buildings using this type of information offers an interesting and hopefully useful method for gaining a better understanding of the potential for and the application of energy efficiency improvements in the commercial sector.

39054 **(CONF-870816—20) Techniques for in situ determination of thermal resistance of light weight board insulations.** Courville, G.E.; Beck, J.V. (Oak Ridge National Lab., TN (USA); Michigan State Univ., East Lansing (USA). Dept. of Mechanical Engineering). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011118.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

The most common method for field measurement of building component thermal resistance is the "averaging" method, $R = \Sigma\Delta/\Sigma q$, defined as the ratio of the average temperature over some suitable period of time to the average heat transfer over the same time period. While simple to use, it does have shortcomings: (1) the ratio is unreliable when the average heat transfer is near zero as it often is during the spring and fall seasons, (2) the R-value reported is at best an average over the range of temperatures for the test, and (3) the method does not account for persistent effects related to material heat capacity. Three alternative methods, all of which also use measured temperature distributions and heat fluxes are described. The "absolute value" method avoids problem (1), and the "steady

state least squares" method avoids (1) and (2). The most comprehensive method is PROPOR. PROPOR is based on heat transfer principles and addresses all three of the shortcomings of the averaging method. Experimental data is presented to support these conclusions.

39055 **(DOE/CE/63476—T1) Pacific Asian Consortium in Employment: Energy Related Business Development Grant: Final performance report.** (Pacific Asian Consortium in Employment, Los Angeles, CA (USA)). 6 Jul 1987. Contract FG01-86CE63476. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012090.

Potential ventures were identified for energy savings businesses development ventures. The venture will be Home Remodeling, Additions and Weatherization component for the existing PACE for-profit company, Lotus Construction. (DLC)

39056 **(DOE/CE/63477—T5) MCCAA [Mercer County Community Action Agency] residential ESCO [Energy Service Company] market study.** (ACTION-Housing, Inc., Pittsburgh, PA (USA)). [1987]. Contract FG01-86CE63477. 118p. NTIS, PC A06. File Number DE87012154.

Bases upon its experience in publicly funded weatherization programs, the Mercer County Community Action Agency has become interested in the possibility of expanding the scope of their energy conservation activities to the larger population. That is, those homeowners whose income disqualifies them for publicly-funded weatherization programs, but who may be willing to purchase similar energy reduction and comfort enhancing services from a private entity. This market study, undertaken by ACTION-Housing, Inc., attempts to describe the potential market for residential energy management services in Mercer County and to offer relevant strategies for developing a for-profit, residential energy service company capable of responding to the specific market conditions uncovered.

39057 **(DOE/CE/63496—T1) Syracuse Energy Service Company: Summary final performance report.** (Syracuse Energy Service Co., Inc., NY (USA)). 6 Jul 1987. Contract FG01-86CE63496. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012078.

Through New York State Department of Energy weatherization funds proposed weatherization loan funds established under the oil over charge programs is discussed. SESCO has a real role in assisting low-income building owners access to this loan fund. The final financial status reports for the grant, the final federal cash transaction report, the final performance report and property and pattern certificate forms are included.

39058 **(DOE/EV/10450—H1) Indoor air quality environmental information handbook: Building system characteristics.** (Mueller Associates, Inc., Baltimore, MD (USA); Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC01-81EV10450;AC02-76CH00016. 290p. NTIS, PC A13. File Number DE87010330.

This manual, the third in a series, focuses on residential building system characteristics and their effects on indoor air quality. The manual addresses: residential indoor air pollutants by source, indoor concentrations, health effects, source control and mitigation techniques, standards and guidelines; building system characteristics of air exchange, pollutant source strength, residence volume, site characteristics, structural design, construction, and operation, infiltration and ventilation system, building occupancy; and monitoring methods.

39059 **(EEO-ED—105-127) Monitoring of a microprocessor based energy management system. A demonstration project at various tenanted office buildings. Final report.** (ERA Technology Ltd., Leatherhead (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Department of Energy, London (UK). Energy Efficiency Office). Nov 1986. 63p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752797.

Annual savings ranging from Pound4,700-Pound17,300 are currently being realised by a number of different organisations installing energy management systems in their premises. The system used is one manufactured by Trend Control Systems Ltd and installed by Energy Technique (ET); ET have installed systems in ten multi-tenanted office blocks to control heating, ventilation and air conditioning plants (HVAC). Having installed and commissioned the EMS in the buildings, ET remotely monitored and controlled the HVAC in each of the buildings via the STD network from their own offices in Basingstoke. The project was undertaken to demonstrate that the implementation of centrally controlled EMS, was an effective technology for conserving energy and could provide satisfactory energy saving returns on a company's investment. The results obtained vary for different buildings. Data obtained over a two-year period shows that most buildings achieved extremely worthwhile returns on investment, the majority realising payback periods of 1.7-2.9 years.

39060 **(EPRI-EM—5168) Proceedings: Meeting customer needs with heat pumps.** (Policy Research Associates, Inc., Reston, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 475p. (CONF-860477—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481.

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The seminar, "Meeting Customer Needs with Heat Pumps," was held in Kansas City, Missouri, April 7 to 9, 1986. The meeting was sponsored by the American Public Power Association, the Edison Electric Institute, the Electric Power Research Institute, and the National Rural Electric Cooperative Association. The seminar was designed by the sponsors to meet the information needs of electric utility customer service organizations in marketing residential and commercial heat pumps. The information presented at the seminar included current heat pump technologies and applications; the market potential for heat pumps in the residential and commercial sectors; and discussions of successful utility heat pump marketing programs. Also featured was an exposition of heat pump equipment, utility heat pump advertising materials, and software. Each paper has been separately indexed for inclusion in the Energy Data Base.

39061 **(EPRI-EM—5280) Design goals for advanced heat pumps: Engineering economics methodology: Final report.** Petersen, S.R. (National Engineering Lab. (NBS), Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 186p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920471.

An advanced heat pump (AHP) could make significant improvements in both the seasonal efficiency and peak power demand characteristics of all-electric equipment for space heating and cooling and water heating in residential and small commercial buildings. At the same time, however, the initial cost premium of an AHP must be low enough to make it a competitive offering in the heating and cooling marketplace of the 1990's. An essential step in the research and development process is the evaluation of the economic benefits of alternative AHP candidates. A present, residential electric rates do not provide an adequate basis for measuring such benefits in terms of actual resource utilization, especially with regard to power demand. For this reason, incremental electricity supply costs are developed in this report for typical utilities in different regions of the United States. These costs include both energy and demand charges on an hourly basis. A methodology is established to estimate the hourly kWh consumption of air-source heat pump systems with and without integrated water heating capability and to determine the annual operating cost of these systems based on the incremental electricity supply costs. Alternative design approaches for an AHP are evaluated in this analytical framework in order to determine the cost effectiveness of each approach in each region. Based on a preliminary analysis of a limited number of design alternatives, an air-source heat pump with an Energy Efficiency Ratio at 95°F of 11.0 Btu/Wh, with integrated water heating, and in some regions, an adjustable-speed compressor, appears to be the most economic candidate for an AHP.

39062 (EUR—10007, pp 33-44) **Research on new pairs for domestic absorption heat pumps.** Rolland. (Gaz de France, 93 - Saint-Denis). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The goal set for this study, was to "find" fluid pair that satisfied criteria for technological simplicity reliability and security required for the development on the market of an absorption heat pump for domestic applications. In an initial phase research covered "medium pressure" calogens such as chlorofluorine hydrocarbons, halogens or otherwise.

39063 (EUR—10007, pp 45-53) **Chlorofluorinated hydrocarbon-organic solvent couples.** Berlocchio, R. (Atochem, 69 - Pierre Benite, France. Centre de Recherches Rhone-Alpes). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The choice of a good chlorofluorinated hydrocarbon/organic solvent couple necessitates a compromise between: - excellent miscibility related to the solvent's polar property and the presence of hydrogen and chlorine in the fluoridated heat generating medium's molecule, - sufficient stability limited precisely by the fluoridated molecule's degree of chlorination. For chlorofluorinated hydrocarbons with 2 carbon atoms, two decomposition reactions have been brought to light leading for one, to an ethylene compound without breaking the C-H bonds and for the other to a chlorofluorinated hydrocarbon after substitution of a chlorine atom by a hydrogen atom.

39064 (EUR—10007, pp 54-70) **Ternary working fluids for absorption heat pumps.** Radermacher, R. (Maryland Univ., College Park, USA. Dept. of Mechanical Engineering). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Most refrigerant-absorbent combinations suggested or actually employed for use in AHPs have consisted of only two chemical species. It is possible, however, that by combining a solid and a liquid absorbent, the first soluble in the second, the resulting mixture might retain the advantages but not possess the liabilities of the individual components. Such combinations have been considered in the literature and gained recently new interest. Here the ternary mixtures ammonia-water-lithium bromide (NH/sub 3/-H/sub 2/O-LiBr) and methylamine-water-lithium bromide (CH/sub 3/NH/sub 2/-H/sub 2/O-LiBr) are considered. The binaries ammonia-water and methylamine-water possess very favourable thermodynamic and heat and mass transfer characteristics but both require rectification to remove water from the refrigerant vapor. Lithium bromide is a non-volatile salt in the temperature ranges of interest here and is an absorber for ammonia or methylamine as well as water. The ternary systems, ammonia or methylamine and water plus lithium bromide have the advantage that for at least pairs of the three components the thermodynamic and materials compatibility properties are well known.

39065 (EUR—10007, pp 71-78) **Absorption fluids data survey.** Macriss, R.A. (Institute of Gas Technology, Chicago, IL, USA). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The overall objective of this study is to develop improved data for the thermodynamic, transport and physical properties of absorption fluids. A specific objective of this phase of the study is to compile, catalog and coarse-screen the available U.S. data of known absorption fluid systems and publish it as a first edition reference document to be distributed to manufacturers, researchers and others active in absorption heat pump activities.

39066 (EUR—10007, pp 81-93) **Transfer modeling in an absorber.** Grossman, G. (Israel Institute of Technology, Haifa. Faculty of Mechanical Engineering). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This paper attempts to describe the present state of knowledge on heat and mass transfer modelling in film absorption. Following a survey of film hydrodynamics, the transfer processes are described according to their flow regime. Effects leading to transfer enhancement are discussed.

39067 (EUR—10007, pp 94-107) **New type of absorbers.** Prevost, M.; Huor, M.H.; Bugarel, R. (Institut du Genie Chimique, 31 - Toulouse, France). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In absorption heat pumps and heat transformers the temperature upgrading takes place between the evaporator and the absorber. Besides, the working conditions in the absorber are such that both are close to the equilibrium so it is necessary to remove very quickly the heat evolved by the absorption: this shows the great importance of the absorber. In this paper results on three kinds of absorbers will be presented: - tubular absorbers using: tangential feed, corrugated tubes, - jet absorber. First of all a model of the absorber taking into account energy and mass transfer has been obtained. This model can be used in two ways: data acquisition and simulation.

39068 (EUR—10007, pp 119-125) **Multi-stage absorption heat pump with storage capacities of exergy for heating buildings. Energetic and economic evaluations.** Le Goff, P.; Dietrich, E.; Trap, J.C. (ENSIC, 54 Nancy, France. Laboratoire des Sciences du Genie Chimique). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In an absorption heat pump, a mixture is separated into its constituents by thermal vaporisation-condensation. At a later time, these constituents are remixed by an operation which also involves a thermal vaporisation-condensation. In the case of the home-heating system, the separation is performed at no extra cost since use is made of the large thermal gradient between the flame at 1200 deg C and the heated water at 50 deg C. On the other hand, the mixer produces a second useful heat flux by drawing energy from the environment. It is obviously not necessary that the mixing and the separation be done simultaneously.

39069 (EUR—10007, pp 126-137) **Modelling and simulating the dynamic behaviour of a falling film absorber.** Butz, D. (Stuttgart Univ., Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Absorption experiments are most commonly conducted at steady state conditions to obtain data for design purposes of a special type of absorber. However, it is often important to know the dynamic behaviour of the absorber in order to assess changes in the input variables. For this purpose a dynamic model of a falling film absorber was developed. With the result of a simulation based of this model one can decide on the optimum size of the apparatus and deduce a control strategy to reduce the impact of disturbances on the governing variables such as heat and mass flow rates, concentrations and temperatures.

39070 (EUR—10007, pp 138-146) **Analysis of a vertical tubular two-phase absorber.** Yaron, I. (Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel. Institutes for Applied Research). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This communication outlines the analysis and procedures for the design of vertical tubular two-phase absorbers in which simultaneous heat and mass transfer occurs between the phases. Using appropriate data for phase equilibria, and thermodynamic and transport properties for specific refrigerant-absorbent combinations together with overall inlet-outlet specifications for an absorber in a given application, the analysis permits calculation of several absorber configurations, from which the optimal design may be obtained.

39071 (EUR—10007, pp 147-156) **Application of compact heat and mass exchangers in sorption systems.** Iedema, P.D.; Minkhorst, J.H. (FDO Technical Consultants, Hengelo, Netherlands). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The application of Compact Heat and Mass Exchangers in sorption systems is a logical consequence of the explicit emphasis on the development of cheap manufacturing techniques for sorption hardware. Thus highly automatized quantity production may be realized of sorption systems with improved performance while being more compact and of lower weight than conventional systems. Here the availability of cheap transfer area and the possibility of multichannel heat exchange leads to the economic feasibility of advanced cycles. This finds its most optimal realization in Integrated Circuit sorption systems, in which the conventional complex of heat and mass exchanging components has been replaced by a single rectangular block.

39072 (EUR—10007, pp 159-164) **Advanced absorption cycles.** Alefeld, G.; Ziegler, F. (Muenchen Univ., Garching, Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Rules for the design of advanced heat pump which are based on the conservation laws for mass, energy and in particular exergy, are formulated such that the design work is reduced to a simple domino-like game, using elementary cycles as building units for more complicated circuits. The rules can be applied to cascading as well as to integrated systems. Applying the rules it is possible to find and compare competing cycles, by which a given problem can be solved. It is possible to make statements about the minimum number of exchange units, required to bridge a given temperature gap between the low, medium or high temperature heat. (The term "exchange unit" stands for condensor, evaporator, generator, absorber, resorber or desorber, i.e. for those units in which the working fluid performs a phase transition and consequently heat must be added or rejected). The design rules can be applied to combinations of absorption with absorption cycles or with compression cycles.

39073 (EUR—10007, pp 165-174) **Alkali metal hydroxide/water absorption heat pump.** Smith, I.E.; Carey, C.O.B. (Cranfield Univ., UK. School of Mechanical Engineering). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The alkali-metal hydroxide/water heat pump has been shown to be capable of absorbing heat from air at temperatures below zero, pumping this heat into water heating systems with a return temperature of around 60 deg C or greater, and providing a 32% saving in primary energy input to a heating system. The system has operated stably and at all times the internal pressures were below atmospheric. Further research is required in the vapour absorber, in order to improve temperature lift still further, but there is no reason why an all-metal demonstration model should not now be constructed and demonstrated from information that is at present available.

39074 (EUR—10007, pp 175-188) **High-performance cycles with auxiliary fluid.** Cheron, J.; Rojey, A. (Institut Francais du Petrole, 92 - Rueil-Malmaison). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The use of an auxiliary fluid very appreciably increases the cooling effect at the level of the evaporator, an effect that is all the greater as the temperature difference at the level of the evaporator is great; and the cycle with one absorber easily increases the COP without any major change having to be made in the standard cycle. When the temperature difference in the evaporator is not very great and the evaporator-absorber temperature difference increases, the cycle with two absorbers preserves the increase provided by the presence of the auxiliary fluid (which itself may be a mixture of fluids).

39075 (EUR—10007, pp 189-194) **Application of the I.F.P. patent on the absorption heat pump with auxiliary fluid as applied to apartment building heating.** Fournier. (Compagnie Industrielle pour les Applications Thermiques, C.I.A.T., 01 - Culoz, France). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

C.I.A.T. is in the process of building an absorption heat pump with an output of 100 kW using a double absorber, and functioning with water/ammonia and an auxiliary fluid. This machine is well advanced at our Culoz plant and will be tested in the Laboratories of Gaz de France (G.D.F.) at Saint-Denis.

39076 (EUR—10007, pp 195-205) **Selection of preferred cycle and fluids for a high efficiency, direct fired, absorption heat pump.** Hayes, F.C.; Modahl, R.J. (The Trane Company, La Crosse, WI, USA). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This paper deals with the status of an advanced absorption heat pump program being conducted by The Trane Company, with support from the U.S. Department of Energy. The overall objective of the program is the evaluation, development, and proof testing of advanced absorption refrigeration cycles which are applicable to residential and commercial space conditioning systems. Phase I of the program involved the analytical evaluation of cycles and fluids.

39077 (EUR—10007, pp 206-227) **Compression heat pump with solution circuit.** Stokar, M.; Trepp, C. (Swiss Federal Institute of Technology, Zurich). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The design of a 3-12 kW compression heat pump with solution circuit has been discussed. A pilot plant has been constructed at the Swiss Federal Institute of Technology in Zuerich. The plant is designed to heat water from 40 deg C to 70 deg C and to cool water from 40 deg C to 15 deg C. First experimental values are given. The experimental COP is 3.95 while a good 1-component NH/sub 3/ heat pump with 3-stage condenser reaches a maximum of 3.35. This is equivalent to an energy conservation of 15%.

39078 (EUR—10007, pp 231-238) **Cascading two-stage sorption chiller system consisting of a water-zeolite high temperature stage and a water-LiBr low-temperature stage.** Ziegler, F.; Brandl, F.; Voelkl, J.; Alefeld, G. (Muenchen Univ., Garching, Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

An adsorption heat pump based on the system zeolite-water has been built and tested. A temperature lift of 80 deg C and more can be reached with a COP of 1.2 to 1.3. If no heating is required the temperature of the output heat is high enough to drive an absorption chiller. The coupled system could reach a COP for cooling of over 1.2.

39079 (EUR—10007, pp 239-249) **Methanol-calcium chloride absorption cycles.** Ravelet, R. (Compagnie Generale d'Electricite, CGE, 91 - Marcoussis, France). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

We are studying heat pumps with an intermittent cycle of solid-gas chemisorption which display simultaneously an energy storage effect in a chemical form and a heat pump effect. We are studying the calcium chloride-methanol pair, which exhibits some interesting properties: formation of stable coordination compounds for reaction temperatures ranging from 50 deg C to 200 deg C, with reaction energies ranging from 20 to 100 kJ/mole. Possibility of working below 0 deg C. Chemical incertia of calcium chloride and methanol in relation to the majority of the usual metals. Low cost and abundance of the chemicals CaCl/sub 2/ and methanol.

39080 (EUR—10007, pp 250-263) **Development and performance of a directly fired and periodically operating absorption heat pump.** Knoche, K.F.; Grabenhenrich, H.B. (RWTH Aachen, Germany, F.R. Lehrstuhl fuer Technische Thermodynamik). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

A directly fired and periodically operating absorption heat pump has been designed and built for space heating applications. Extensive investigations have been performed to determine the heat and mass transfer rates in the necessary components for the ternary mixture methanol-water/lithiumbromide. The results of those preliminary experiments, especially the achieved mean heat output and the overall heat transfer coefficients, proved that a technically scaled unit can be designed and constructed with an acceptable overall size. Operation modes and the required components have been defined for a 10 kW-prototype. The unit has been built and then installed in a heat pump testing rack. The primary energy ratio PER has been determined for varying operating conditions. Unlike continuously operating heat pump systems, which at partial load are working in the on/off-mode, the periodically operating heat pump ascertaines an increasing primary energy ratio especially at partial load. An increase of annual efficiency up to 40% compared with conventional furnaces can be expected for an optimized device.

39081 (EUR—10007, pp 264-272) **Study of solid-adsorption heat-pump connected with external heat reservoirs of finite heat capacity: case study of the zeolithe-water pair.** Karagiorgas, M.; Meunier, F.; Rios, J. (Paris-11 Univ., 91 - Orsay, France. Laboratoire de Thermodynamique des Fluides). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In this publication we discuss the possibilities brought by the solid-adsorption cycles. We present the results of our work about the cycles using the zeolithe water pair with a configuration where zeolithe is heated (or cooled) through a thermal fluid. In a first part, we strive to situate the possibilities of these cycles. Then, we present the results of our measurements of feasibility performed on a laboratory unit. Finally, we present the results of our numerical simulation and we compare these numerical results with the experimental ones.

39082 (EUR—10007, pp 273-278) **Solid-gas chemical heat pump.** Bodiot, D.; Spinner, B. (Perpignan Univ., 66025, France. Lab. Ultra Refractaires). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The chemical heat pump (CHP) using the reaction of a gas with a solid needs two coupled reversible reactions in two reactors fitted together by a gas pipe. The choice of reactants is obtained using different criteria: application to building heating, use of thermal wastes, security regulations (pressure under 8 bars) corrosion. The reactants used are: NH/sub 3/ with BaCl/sub 2/ and SrCl/sub 2/, NH/sub 2/CH/sub 3/ with CaCl/sub 2/, SrCl/sub 2/, MnCl/sub 2/ and ZnCl/sub 2/. Using these reactants the temperature measurements for fixed pressures give information on heat and mass transfer. The power of such devices increases quickly if one gets out of equilibrium conditions by compressing the gas.

39083 (EUR—10007, pp 279-287) **LiCl+CaCl/sub 2//H/sub 2/O pair.** Isshiki, N.; Kamoshida, J. (Nihon Univ., Tokyo, Japan; Shibaura Inst. of Technology, Japan). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Absorption heat pump is very useful for the utilization of new energy of low temperature difference by the following four view points. (a) possibility of using any kind of heat source of low temperature difference natural energy and industrial waste heat. (b) Possibility of being used for either of both generation of heat and power (co-generation), (c) good for long term storage and distance transportation of energy. (d) Possibility of applying any kind of chemical pair which have reversible thermo-chemical reaction with a lot of varieties. Among many thermo-chemical pairs, the pair of LiCl + CaCl/sub 2//H/sub 2/O has been selected and investigated in the R and D of developing power generation system. The reason of this selection is that this pair have been thought to be most practical, inexpensive, and powerful for our purpose. The system of heat and power cogeneration system has been selected as the object of application of the absorption system, and especially power generation has been studied. Then, in order to inquire the possibility of power generation and energy storage, a four wheeled vehicle driven by the power of the pair of L1Cl = CaCl/sub 2//H/sub 2/O has been assembled and tested with success. In this paper the general aspects of this study is reported briefly, and the future possibility of the absorption heat pump and power generation is discussed.

39084 (EUR—10007, pp 288-300) **Some results from the development of a solid-absorption refrigerating system.** Worsoee-Schmidt, P. (The Technical University of Denmark, Lyngby. Refrigeration Laboratory). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In recent years there has been an increasing interest in solid absorption, primarily in connexion with the so-called chemical heat pumps and storage of thermal energy at fairly low temperatures. With multi-stage systems solid absorption also offers possibilities for high temperature heat pumps. From a thermodynamic point of view ammoniates of metal haloids are particularly interesting for the latter application. They constitute a large number of possible absorbents with equilibrium properties covering a wide range of temperatures, but so far rather scant thermodynamic data are available, particularly higher ammonia pressures. Recently, the solid-absorption cycle has gained renewed actuality in connexion with solar-powered refrigeration for developing countries. An extremely simple and reliable solid-absorption system for small ice-pack freezers and village-size refrigerating plants has been developed and is now in production. Some of the experience with the calcium chloride/ammonia system gained during this work may be of interest also for heat-pump applications.

39085 (EUR—10007, pp 303-313) **Experimental study of a 100 kW prototype loop for an industrial high-temperature absorption heat pump.** Mezon, J. (Gaz de France, 93 - Saint-Denis). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This paper is a report on the first experimental results obtained on the 100 kW prototype loop of an industrial high temperature absorption heat pump, built by Gaz de France and the Creusot-Loire Company. Tests were carried out at evaporating temperatures of 55-65 deg C and useful temperatures of 120-130 deg C. Depending on the temperature range, low values between 1.20 and 1.56 net calorific value were obtained.

39086 (EUR—10007, pp 314-326) **Theoretical study of an industrial absorption dryer.** Mezon, J. (Gaz de France, 93 - Saint-Denis). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This paper evaluates the theoretical performance of an open-circuit absorption heat pump, called an "absorption dryer" where the refrigerant consists of condensed steam from the humid exhaust air of an industrial dryer.

39087 (EUR—10007, pp 327-338) **High temperature non-corrosive absorption working pair.** Erickson, D.C. (Energy Concepts Co. Annapolis, MD, USA). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

This paper is a survey of several ongoing activities or discoveries of Energy Concepts Company which are of prospective interest to the absorption cycle research community. The new high temperature absorbent is particularly highlighted.

39088 (EUR—10007, pp 339-354) **Absorption heat pumps (AHP) for heating capacities ranging from 300-3,000 kW.** Renker, M.; Hensgens, M. (Linde Corporation, Koeln, Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Based on the experience gained with NH/sub 3/ refrigeration plants operating on ammonia/water (NH/sub 3/, H/sub 2/O), absorption heat pumps covering a capacity range from 300-3,000 kW have to date been designed and realized. Whenever feasible, the plants were equipped with standardized components but individually designed for the different applications. Up to now there were exclusively realized plants that have one stage of absorption. Additional examples how absorption heat pumps can be designed with multiple stages of absorption and desorption are illustrated. The plants to date realized are in operation for a time of up to 4 heating periods. They are characterized by a high degree of operational reliability, the required maintenance is negligible, and they came fully up to customers' expectations.

39089 (EUR—10007, pp 357-360) **Practical use of absorption heat pumps in the heating of buildings.** Behar, M. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The purpose of this expose is to set out the problems posed by the changeover from research into thermodynamics to the practical application of absorption heat pumps for the heating of buildings. The optimisation of the internal architecture and the choice of working fluids depend on the thermodynamic considerations determined notably by the three temperature levels between which the heat pump is to operate. Once these choices are made, we are faced with the practical problem of coupling these sources to the heat pump itself. Research backed in France by the French Agency for energy management ranges from the fundamental to practical application: pure thermodynamic studies, optimisation of fluid couples, functioning models, association with chemical storage, dimensioning of the various components, construction of industrial prototypes. It covers both absorption and adsorption pumps, heat and cold generation, continuous and discontinuous cycles. Certain studies are common to compression heat pumps, for example, such as those relating to non-glazed collectors, called atmospheric collectors, as mentioned in paragraphe 3. Finally, we should of course, mention the economic studies which show the minimum economically viable capacity of an absorption heat pump at the moment, that is to say, with an outlay return time of under 5 or 6 years, is at least several dozen KW with gas or fuel-oil as the fuel.

39090 (EUR—10007, pp 361-377) **Absorption heat pump economic study.** Lafay, R. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In France, there are two types of application for heat pumps, particularly the absorption type: - heating of buildings, - certain industrial processes. As a result, three main sectors may use them: - private housing, preferably collective, - the tertiary sector, mainly in its "accomodation" part, - industry, particularly for the drying of products and the heating of liquids. A rapid analysis of these three sectors enables us to determine the potential importance. The absorption heat pump has, under present conditions and in the field described here, relatively limited economic prospects. However: - low-cost improvements in its performances, - appreciable reductions in its installation cost, may significantly alter the situation and bring them to a possible competitive level. Other fields better using the specific qualities of absorption heat pumps should enable them to be put to better use.

39091 (EUR—10007, pp 378-384) **Results and future development of absorption heat pump research funded by the European Community.** Zegers, P. (Commission of the European Communities, Brussels, Belgium). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In the framework of its second energy R and D Programme (1979-1983) the Commission of the European Communities carried out R and D on absorption heat pumps. Nine projects have been carried out on the development of new fluid pairs, components and industrial heat pumps. A third four-year Energy R and D Programme has been approved in December 1984. Work on absorption heat pumps will be one of the focal points in this programme, with emphasis on the development of absorption heat pumps with new fluid pairs and high temperature heat pumps for industrial application.

39092 (EUR—10007, pp 385-398) **Absorption heat pump with organic fluid pair.** Matsuo, K.; Kunugi, Y.; Usui, S. (Hitachi, Ltd. Tsuchiura, Japan. Mechanical Engineering Research Laboratory). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

A prototype air-sourced heat pump type absorption air-conditioner has been developed, whose main features are 1) use of R22/TEGDME (tetraethyleneglycol dimethylether) pair, 2) high coefficient of performance (COP) both in heat pump and cooling operations, and 3) continuation of heating during defrost. The developed prototype has achieved the heating COP of 1.37 and the cooling COP of 0.5, and maintained 80% of heating capacity during defrost.

39093 (EUR—10007, pp 399-414) **Absorption heat pumps with R22 and organic solvent.** Kawamoto, H.; Takata, Y.; Shibuya, K. (Osaka Gas Co., Ltd., Japan. Gas Utilization Development Center). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Working fluid for gas-fired air heated absorption type heat pumps was studied. The following conditions are required: it should work as a fluid for a double effect absorption system; it should work even at temperatures below zero degree centigrade; it can be air-cooled; it should make a high C.O.P.; it should be stable and safe. One hundred and fifty organic solvents combined were studied. As a result R22-amide and R22-glycol ether were found most effective. The total C.O.P. under the standard condition in cooling is 0.55 and in heating is 1.24. A simulation method for this system was developed as a design tool for components and controls.

39094 (EUR—10007, pp 415-425) **AWT-gas absorption heat pump.** Meckel, M. (Wesfalische Fernagas-AG, Dortmund, Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The AWT-GAWP system uses ammonia and water as working fluid. The solution circuit comprises an expeller, solution valve, pre-absorber, main-absorber, solution pump and dephlegmator and the refrigerant circuit comprises a condenser, refrigerant heat exchanger, expansion valve and evaporator. Pressure and temperature limiting devices are provided in the cooling circuit to prevent limit values being exceeded. In addition a hot water thermostat switches off the appliance when the initial temperature of max. 53 deg C has been reached. The exhaust gas and air fans are also monitored. Heat sources used include: ground water; soil; ground collector tubes; soil; ground probes, solar energy; energy roof, solar energy, energy fence, outside air. GAWP appliances are also used for heat recovery in indoor swimming pools. In combination with various heating systems such as under floor heating, low temperature and high temperature radiator heating and air heating all conceivable types of operation (monovalent: solo, alternative and parallel) have been used. With account taken of tax benefits, higher costs of electricity and the maintenance, the amortisation period is 7.9 years which, given as service life of 15 years, shows that in this case the GAWP is a good economic proposition.

39095 (EUR—10007, pp 426-443) **Gaz de France research into prototype absorption heat pumps.** Genest, B. (Gaz de France, 93 - Saint-Denis). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

A record of the research carried out by Gaz de France on domestic absorption heat pumps. This research led to the creation of the Pacha 1 pilot laboratory and two "pre-industrial" prototypes called Pacha 2 and Pacha 3. The results obtained with Pacha 3 are given along with future actions planned by Gaz de France concerning the prototype, an economic approach also analyses the development prospects of absorption heat pumps.

39096 (EUR—10007, pp 444-451) **First phase of industrialisation of an absorption heat pump project.** Pierson, J.L. (Total Energie Developpement, 69 - Lyon-Vaise, France). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In this report, we present how we build an outside air/water absorption heat pump prototype, using organic fluids and looking like the marketed product will be.

39097 (EUR—10007, pp 452-467) **Test rig data, process data and operating data for a prototype air-to-water absorption heat pump.** Muehlmann, H.P.; Wessing, W. (Rhurgas AG, Dorsten, Germany, F.R.). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The prototype tested is an air-to-water absorption heat pump using ammonia/water as working fluid. The space heating requirement was 25 kW on the coldest day (-15 deg C outdoor temperature). In the theoretical model of a 70/50-20 space heating system (radiators), the flow temperature at -15 deg C outdoor temperature is 70 deg C, return temperature is 50 deg C and the heat requirement is 25 kW. No heat is required for space heating at 20 deg C outdoor temperature and at this temperature both the flow and the return temperature is 20 deg C. In the 70/50-20 model, the quantity of heat required for space heating purposes at -1 deg C outdoor temperature is 15 kW, flow temperature is 50 deg C and return temperature 30 deg C. The absorption heat pump was required to provide heat to this temperature limit and was therefore designed for an output of 15 kW. In theory, the heat pump would meet 60% of heat requirements on the coldest days and 78% of annual heat load. When the outdoor temperature drops below -1 deg C, a conventional 25 kW boiler would be used to meet space heating requirements.

39098 (EUR—10007, pp 468-473) **Development of absorption refrigeration and heat pump units with organic working fluids.** Borde, I. (Ben-Gurion Univ. of the Negev Beer-Sheva, Israel. The Institutes for Applied Research). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The purpose of this communication is to present an overview of our recent research on the development of absorption units powered by low-temperature heat sources. Our research effort was devoted to two main projects. The first was the development of refrigeration units that would permit direct-contact heat transfer between a nontoxic liquefied refrigerant and the material to be cooled. The second project was the development of heat pumps with working fluids at relatively low pressures. For both projects we had to find appropriate refrigerant-absorbent combinations.

39099 (EUR—10007, pp 474-502) **Potential for gas-fired heat pumps in domestic heating.** Miriam, J.M. (British Gas Corporation, London. Watson House). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

The specification for a gas-fired heat pump which is capable of competing with the domestic gas boiler is stringent in terms of first cost, performance and the space available within the house. It is unlikely that the specification will be met with the systems already developed and new technology for the operating fluids used in the cycle, for the means of control and component design is required. Gas-fired absorption cycle heat pumps for domestic heating are still at the prototype and field testing stage, although a variety of thermal and mechanical cycles are being investigated. Although a few designs are reaching the market place, the search continues for alternative fluid pairs and cycle variation which will eventually result in a reduction in capital cost.

39100 (EUR—10007, pp 503-516) **Part load performance of absorption heat pumps.** McLinden, M.; Radermacher, R. (National Bureau of Standards, Washington, DC, USA; Maryland Univ. College Park, USA). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

In residential applications, absorption heat pumps are expected to meet the building heating or cooling load like other equipment. Since this load varies widely with the outdoor temperature, means have to be provided to adjust the capacity of the absorption equipment accordingly. In principal there are two methods available. The first implies cycling of the equipment, which means turning the unit on and off so that the time averaged capacity just meets the building load. The second method consists of adjusting the heat input to the unit so that the capacity at any instant matches the load. Both methods have their inherent advantages and disadvantages. In this paper experimental results will be presented for absorption equipment that employs cycling as means for control of the part load capacity. Some of the causes for the degradation of the part load performance have been experimentally verified. Based on these results a theoretical comparison of the relative means of cyclic control versus modulation is attempted.

39101 (EUR—10007, pp 517-528) **Application of gas-fired absorption heat pump for commercial purposes.** Ikari, M.; Kurosawa, S. (Tokyo Gas Co., Ltd., Japan. Air Conditioning and Heating Section). 1985. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132. (CONF-8503282—).

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

As a method of saving energy and utilizing heat effectively, recovery of low temperature waste heat has become significant. Heat pumps are assumed to be the most appropriate to that purpose. Since a waste heat recovery system must satisfy diversified requirements from both the waste heat source side and waste heat use side, the most suitable heat pump system must be chosen according to the conditions of each installation site including economics. The gas fired absorption heat pump has sprung from gas fired absorption water chiller-heaters, which are used in a large number in Japan. Its applications in commercial field and the results of its field tests are discussed here.

39102 **(EUR—10007) Absorption heat pumps congress. Proceedings of the congress.** (Commission of the European Communities, Luxembourg). 1985. 515p. (CONF-8503282—). NTIS (US Sales Only), PC A22/MF A01. File Number DE87780132.

From Absorption heat pumps congress; Paris, France (20 Mar 1985).

Papers presented at the absorption heat pump congress are included. Each paper has been separately indexed for inclusion in the Energy Data Base.

39103 **(EUR—10160-Vol.1) Pilot study of heating by heat-pump and heliogeothermy: description and 1983 balance.** Iris, P. (Commission of the European Communities, Luxembourg). 1986. 66p. (In French). NTIS (US Sales Only), PC A04. File Number DE87752649.

The aim of the contract was to control, on a scientific plan, a system of space heating by heat pumps on an underground aquifer: the heliogeothermal doublet. This system is an answer to the problem that would generate an important heat pump exploitation of aquifers (with low regional velocity) in urban areas. It has been applied to the case of a regional aquifer of the parisian region, at 80 m depth, 13/sup 0/C, which flow rate per well (about 60.80 m/sup 3//h) makes it attractive both on technical and economical plans, for collective buildings (200 apartements and more) and offices buildings. The objective of the contract was: - To control on the scientific point of view the construction of the installation which technical characteristics had been defined in a precedent contract (tests of the wells, heat pumps, convectors, designing of a data acquisition system, etc...). - To make a mathematical model of simulation of the complete system (time step: one hour). - To interpret the first results and to calibrate the model. The system started operating in 1983, March: the heat pumps work as previously; the wind collectors have lower performances, mainly because of wind velocity which is half the meteorological values taken into account in the design calculations. According to the sizing of the collectors, this does not create majors problems for the general behaviour of the installation. At least, it appears necessary to control the behaviour of the wells during their exploitation, especially for the injection. During winter 1983-1984, 90% of the heat were delivered by the heat pumps with an average COP of 3.4 (taking into account pumpage and auxiliary energy).

39104 **(EUR—10160-Vol.2) Pilot study of heating by heat-pump and heliogeothermy: first results of a model simulation model installation (SYSTHERM).** Bonfils, R. (Commission of the European Communities, Luxembourg). 1986. 21p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752645.

The first results obtained regarding the validation of the simulating heliogeothermic installation model are encouraging. The working of the new sequences measured at the rate of one hour or less in a system which at present functions in a very satisfactory manner, and certain modifications used in the model will permit the continuation of the identification work undertaken and facilitate the reliability of the model for prediction of the balance of heating in the winter and recharging in the summer, and the detailed simulation of the function to the installation.

39105 **(IKE—7-7) Energy diagnosis for residential buildings.** Ast, H.; Bach, H.; Diemer, R.; Koenig, R.; Wagner, J.; Gertis, K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Jan 1986. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770164.

The technique 'Energy Diagnosis' was developed to assess the thermal state of residential buildings with oil- and gasfired central heating systems. For each specific building a choice of economic retrofits of the structure and the heating system is provided. This method was applied to 14 residential buildings - single-flat and multi-flat houses. The results indicate, that energy saving rates can be related only to the specific building. Energy saving rates due to retrofits of the structure strongly depend on the behaviour of the occupants.

39106 **(NP—7752237) Work programe of the Institute 1986/1987.** (Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.)). Feb 1986. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752237.

The Institute tries to make suitably processed research results available to the Land of Hesse, as aids in decision making on questions of dwelling and town planning policies, energy and environmental policies, land planning, traffic and social policies. The project work is concentrated on the following main points of the work: A. Flat market and support policy; B. Legal and organisational problems of flat dwellers, C. Living accommodation problems of disadvantaged groups; D. Living environment; E. Town development and F. Energy use. Within the subject of energy use, one assumes that the achievement of careful and rational, environmentally and socially acceptable energy strategies and concepts is opposed more by obstacles in the process of realisation rather than gaps in basic knowledge, so that it is most important that users should be better informed on the current state of systems of rational energy use and the conditions of use of these systems and that these users should be advised whether they are individual households or investors, for which purpose consultancy institutions should be created by the Land, or whether they are local companies, who take the principles of rational use of energy into account and must convert them into energy concepts.

39107 **(ORNL/Sub—84-47989/2) Absorption fluids data survey: Final report on foreign data.** Macriss, R.A.; Gutraj, J.M.; Zawacki, T.S. (Institute of Gas Technology, Chicago, IL (USA)). Apr 1987. Contract AC05-84OR21400. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011975.

In a 12-month evaluation, 300 different foreign publications containing data that relate to properties of binary, ternary, and multicomponent absorption fluids were identified; from these publications, 127 were selected as sources of relevant foreign data. Fluids covered include combinations of each of 20 different refrigerant compounds, with one or more of 41 single, 13 binary, and 6 ternary absorbent compounds. Generally, the 20 refrigerants are divided among the following categories of chemical compounds - INORGANIC 2, ORGANIC 18 (amines 2, alcohols 5, halogenated 10 and hydrocarbons 1). Likewise, the single absorbent compounds generally are subdivided as follows - INORGANIC 11, ORGANIC 30 (alcohols 7, ethers 4, alcohol-ethers 1, amides 2, amines 1, esters 7, ketones 2, acids 1 and others 5). The binary and ternary absorbents are various mixtures of two or more single absorbent compounds. Coarse screening and evaluations were performed. Data gaps for key fluids are summarized and unresolved conflicts in data are noted. Results show that with very few exceptions, all candidate fluids for development activities dealing with advanced absorption heat pump concepts have data gaps that must be addressed in the near future.

39108 **(PNL-SA—14337) Ventilation characteristics of new unoccupied manufactured homes built to the model conservation standards in the Pacific northwest.** Parker, G.B.; Onisko, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 17p. (CONF-870695—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012062.

From 80. annual meeting of the Air Pollution Control Association; New York, NY, USA (1 Jun 1987).

The ventilation characteristics of five new unoccupied manufactured homes were determined over several consecutive weeks in the spring of 1986. These homes were constructed as part of a demonstration program sponsored by the Bonneville Power Administra-

tion to examine the energy usage, indoor air quality, and ventilation characteristics of manufactured homes built to the specifications set forth in the Model Conservation Standards (MCS) established by the Northwest Power Planning Council (The Council) for site-built homes in Vancouver, Washington and in Richland, Washington. Home volumes ranged from 186 m^3 to 364 m^3. Blower door measurements indicated that leakage increased 47% in the single-section home and 21% in the double-section home after transport to the site. The tracer gas data indicated that the AAHXs were not delivering the anticipated fresh air exchange rate in the homes.

39109 **(PNL-SA—14671) Research for development of whole-building energy performance targets.** Crawley, D.B. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 14p. (CONF-8704173—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011991.

From Annual meeting of the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH); Brisbane, Australia (6 Apr 1987).

The primary focus of this project is the development of a flexible methodology for setting targets, rather than the determination of specific numerical target values. Demonstration targets will be generated to show energy efficient solutions for typical economic perspectives, but the main focus is on developing a well-defined target setting methodology that is easy to apply. A research project team comprising representatives from The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), The Illuminating Engineering Society of North America (IESNA), and The American Institute of Architects (AIA), has been conducting the work with project management and technical support provided by Pacific Northwest Laboratory (PNL). Phase 1 of the research project, a planning and proof-of-concept testing effort, has recently been completed. The proposed research and methodology is discussed along with a brief history of energy conservation guidelines and standards in the US.

39110 **Model conservation standards - Lessons learned in providing technical support to the building code industry.** Rowan, S.S. (Bonneville Power Administration). pp 6.55-6.65 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The Northwest Power Act directed the Northwest Power Planning Council (Council) to adopt Model Conservation Standards for new buildings designed to produce all energy savings that are both cost-effective to the Regional power system and economically feasible for consumers. Implementing the Model Conservation Standards, adopted in 1983, has proven to be a challenge for the Council and the Region. In the past two years, the Bonneville Power Adminstration has supported the implementation of the Model Conservation Standards by providing technical support to building code officials and the "code development industry." Two main lessons have been learned. The first one is to take the time, up front, to understand existing infrastructures. Only to learn of their existence is not enough. To understand is to acquire the ability to relate to the history, rationale, purpose and methodology of change of the infrastructure. To understand is to develop a respect for the existing code development industry. The second main lesson is to use this understanding in designing support programs that are consistent with the existing infrastructure, and creatively add to, strengthen and complement it.

39111 **Model conservation standards - Lessons learned from the perspective of designing and managing building code enforcement programs.** Crossman, P.L. (Bonneville Power Administration). pp 6.12-6.24 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In April 1983, the Northwest Power Planning Council adopted Model Conservation Standards for new electrically heated residential and commercial buildings in its long-range energy plan for the region. Shortly thereafter, Bonneville Power Administration (Bonneville) entered a field of conservation previously unfamiliar to the agency: support for the implementation of energy-efficient building codes and/or legally enforceable utility service requirements. This paper focuses on the Northwest region's experience and progress towards implementing mandatory energy-efficiency standards, and discusses the institutional lessons that have been learned along the way. It follows, over a 3-year period, Bonneville's development and operation of building code support programs, and other technical assistance activities designed to encourage voluntary adoption and enforcement of the new Council standards.

39112 **Avoided gigawatts through capital recovery fees and marginal cost pricing of electricity.** Rosenfeld, A.H.; Verdict, M.E. (Lawrence Berkeley Lab.). pp 8.195-8.202 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Advances in building technologies and appliance efficiencies have the combined potential to save up to 50 percent of the electricity demand of new buildings. This paper discusses the advantages and disadvantages of using capital recovery fees for utility hookups and marginal cost pricing of electricity to defer the construction of more than 100 GW of peak power capacity power plants over the next 20-40 years, saving $10-20 billion per year in reduced electricity bills to consumers.

39113 **Market analysis for new commercial building energy conservation.** Gordon, F.M. (Bonneville Power Administration (KEP), P.O. Box 3621, Portland, OR 97208). pp 427-438 of Proceedings of the second great PG&E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—).

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

This paper describes a study of the market for electric energy conservation in the construction of new commercial buildings in the Pacific Northwest. The paper also describes the ways in which the Bonneville Power Administration (BPA) is using the study to develop conservation programs for new commercial buildings and to forecast the potential long-range impact of such programs. The study consisted of three major phases. In the first phase, a qualitative analysis was undertaken of the factors and players influencing the electric energy efficiency of new commercial buildings. This was accomplished through a series of focus groups featuring architects, engineers, contractors, developers, financiers, leasing agents and real estate brokers. Based on that research, the market for new commercial buildings was segmented into two primary categories; owner-built and speculative investments. The role of each profession in making decisions within each market was also identified.

39114 **Bonneville Power Administration's purchase of energy savings.** Schick, H.; McMillan, L.E. (Bonneville Power Administration (KWH), P.O. Box 3621, Portland, OR 97208). pp 393-404 of Proceedings of the second great PG&E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—).

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

The Bonneville Power Administration (BPA) is conducting a commercial buildings retrofit program in the Pacific Northwest by making payments to a sponsor, such as an energy service company or architectural and engineering firm, for energy savings which actually occur in a commercial building. This effort is one of several activities BPA is conducting to develop the capability to

conserve energy in the commercial sector of electrical energy use. This paper describes the benefits of the approach, the program design, lessons learned through field testing the approach, and how the program has been redesigned. Three major benefits to the approach include its ability to meet BPA's borrowing constraints, to directly link BPA payments to energy savings, and to attract a wide variety of sponsors, financing, and commercial buildings to the program. These benefits are discussed in more detail.

39115 **Measured energy performance of new and retrofitted commercial buildings.** Gardiner, B.L.; Piette, M.A.; Meier, A.K. (Buildings Energy Data Group, Lawrence Berkeley Lab., Berkeley, CA). pp 259-268 of Proceedings of the second great PG&E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—). Contract AC03-76SF00098.

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

Due to the diversity and complexity of the commercial building stock, understanding of commercial building energy performance is limited. Measured energy consumption data for commercial buildings are needed to complement engineering calculations and computer simulations of the energy savings and cost-effectiveness of energy conservation measures. To address this need, the Buildings Energy Data Group at Lawrence Berkeley Laboratory has compiled measured energy use data for over 400 new and retrofitted commercial buildings. Most of the new buildings in our data base are operating at energy consumption levels well below stock average. The retrofitted buildings show an average 25 percent reduction in pre-retrofit site energy use.

39116 **Electricity savings due to the BPA Residential Weatherization Pilot Program.** Hirst, E.; White, D.; Goeltz, R. (Energy Div. of Oak Ridge National Lab., Oak Ridge, TN). pp 181-192 of Proceedings of the second great PG & E energy expo, 1985. Smith, C.B.; Davis, T. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—). Contract AC05-84OR21400.

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

The Bonneville Power Administration operated a Residential Weatherization Pilot Program from 1980 through 1982. The program provided free home energy audits to 7200 electrically heated homes in the Pacific Northwest and gave zero-interest loans to weatherize 4100 of these homes. The total cost of the program was almost $11 million. This paper estimates the net energy-saving effect of the BPA program (i.e., the electricity saving that can be directly attributed to the program) as well as the total energy saving. The data used in this analysis include one year of preprogram and three years of postprogram electricity consumption records. The total annual electricity saving experienced by households that received an energy audit and a weatherization loan averaged 5300 kWh/year one year after participation, increasing to 6000 kWh and 6500 kWh two and three years after participation.

39117 **Design of a residential shared savings program: The general public utilities experience.** Brown, M.A. (Oak Ridge National Lab.). pp 151-160 of Proceedings of the second great PG & E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—). Contract AC05-84OR21400.

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

This paper evaluates one alternative involving shared savings, the Residential Energy Conservation Action Program (RECAP). RECAP is novel in that it enables single-family residential customers to have their homes weatherized free of charge. Utility companies contract with energy conservation companies (ECCOs) to install energy conservation measures in homes; the utilities then reimburse the ECCO for the cost of these measures based on an agreed amount for each kWh saved. The objectives of this paper are two-fold. First, the paper seeks to document the RECAP program's activities, problems, and successes for the benefit of the utility industry. Second, it attempts to determine the effects of different program design and implementation strategies on RECAP participation and effectiveness. The paper begins with an overview of the program.

39118 **Bonneville Power Administration's commercial and industrial sector conservation strategy.** Hall, L.K.; Schick, H. (Bonneville Power Administration (KW), 1002 NE Holladay Street, Portland, OR 97208). pp 141-150 of Proceedings of the second great PG&E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—).

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

The Bonneville Power Administration (BPA) is developing the capability to acquire energy conservation as a resource from the commercial and industrial sectors of energy use. The purpose of this paper is to describe the approach BPA has taken to define and build a conservation strategy for the commercial and industrial sectors.

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39119 **(DOE/MC/22123—2281) Coal-fueled diesel locomotive economic assessment.** (General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div.; General Motors Corp., Lagrange, IL (USA). Electro-Motive Div.). Oct 1986. Contract AC21-85MC22123. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006492.

This report presents an initial effort in determining the eonomic viability of a coal-fueled diesel locomotive for the time period 1995 to 2010. The criteria used for determining the economic viability of a coal-fueled diesel is the internal rate of return on investment (IRR). The coal-fueled diesel locomotive is compared to a baseline petroleum-fueled diesel. The coal-fueled diesel locomotive is still very much conceptual, therefore many assumptions are made with regard to cost, operating procedure, fuel form, fuel cost, maintenance, etc. The assumptions are discussed and the spreadsheet calculation procedure used for determining the IRR is presented. Conclusions based on the assumptions and calculations are given.

39120 **(PB—87-185567/XAB) Application of artificial intelligence in the marine industry: problem definition and analysis. Final report. Volume 1. Executive summary. Report for October 1985-February 1987.** Dillingham, J.T.; Perakis, A.N. (Michigan Univ., Ann Arbor (USA). Dept. of Naval Architecture and Marine Engineering). 25 Feb 1987. 25p. NTIS, PC A02/MF A01.

The problem of how to best apply state-of-the-art computer technology, especially using the tools of Artificial Intelligence and Expert Systems (AI/ES) to assist in the solution of several important marine operations problems is addressed. An introduction to AI and ES technology is first presented, including an overview and history, a review of recommended readings, a discussion of when a problem is an appropriate candidate for AI/ES application, available strategies, architectures and ES development tools, and estimates of their associated costs. A cost/benefit analysis of several potential applications in marine operations is conducted. Two of these applications, namely that of optimal container stowage and ship monitoring are examined in detail. Descriptions and formulations of these problems are presented, and estimates of expected monetary benefits are given. Some existing hardware and software tools which are presently in use, or which are now available, are described. Use of these tools for the above applications may improve the overall efficiency and the economic benefits of fleet operations.

39121 **(PB—87-186854/XAB) Application of artificial intelligence in the marine industry: problem definition and analysis. Final report. Volume 2. Technical report. Report for October 1985-February 1987.** Dillingham, J.T.; Perakis, A.N. (Michigan Univ., Ann Arbor (USA). Dept. of Naval Architecture and Marine Engineering). 25 Feb 1987. 198p. NTIS, PC A09/MF A01.

The problem of how to best apply state-of-the-art computer technology, especially using the tools of Artificial Intelligence and Expert Systems (AI/ES) to assist in the solution of several important marine operations problems is addressed. An introduction to AI and ES technology is first presented, including an overview and history, a review of recommended readings, a discussion of when a

problem is an appropriate candidate for AI/ES application, available strategies, architectures and ES development tools, and estimates of their associated costs. A cost/benefit analysis of several potential applications in marine operations is conducted. Two of these applications, namely that of optimal container stowage and ship monitoring are examined in detail. Descriptions and formulations of these problems are presented, and estimates of expected monetary benefits are given. Some existing hardware and software tools which are presently in use, or which are now available, are described.

39122 **(PB—87-187720/XAB) Unsubsidized transit services: potential to meet public needs and reduce subsidy requirements. Final report.** (Urban Mobility Corp., Washington, DC (USA)). Dec 1985. 66p. NTIS, PC A04/MF A01.

Independent commuter-bus services, operated by private for-profit transportation carriers and requiring little or no public subsidies, are functioning in at least 10 metropolitan areas. The majority of these services are express commuter buses operating during peak periods only in a closed door (non stop) mode between suburban park-and-ride lots and central business districts. The study focuses on private-sector involvement in transportation services that require little or no public subsidies--express commuter bus. Part 1 of the report considers independent bus services operated by private carriers including market estimates for unsubsidized commuter services. Part 2 examines privately sponsored services which do not require public subsidies. Each type of private involvement is evaluated in terms of its potential to meet public transit needs and its implications for public financing.

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REFER ALSO TO CITATION(S) 38719, 38754, 39221, 39625

39123 **(BMFT-FB-T—86-163) Development and testing of a process heat generator system. Phase 1. Final report.** Coutelle, R.; Danninger, W.; Gaiser, P.; Nhu-Vinh Nguyen; Thielecke, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Gesellschaft fuer Technische Studien, Entwicklung, Planung G.m.b.H. (SEP), Muenchen (Germany, F.R.); Aerzener Maschinenfabrik G.m.b.H. (Germany, F.R.)). Dec 1986. 157p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770244.

Project objective was the development and testing of a mechanical steam compression system with screw compressor. Up to 7.5 t/h of excess steam from the 4-bar network were compressed and fed into the 9-bar network at the Hoechst AG factory located at Gersthofen. In correspondence to the available quantity in the 4-bar network resp. to the required quantity in the 9-bar network, the steam flow was controlled by speed regulation. Sealing parts and bearings from a dry-running process gas screw compressor of the Aerzener Maschinenfabrik GmbH were modified for application at Gersthofen. To cool the compressor, water quantities regulated according to the temperature at the end of the compression process were injected. To determine the technical and economically meaningful limits of application, the revs/min were varied from 1250 to 3000 rpm, the suction pressure from 2 to 3.5 bar and the final pressure from 4 to 9 bar. With 18 refs., 8 tabs., 73 figs.

39124 **(CONF-8506355—) Scanheating.** (MEFOS-Stiftelsen foer Metallurgisk Forskning, Luleaa (Sweden); Jernkontorets Forskning, Stockholm (Sweden)). 1985. 534p. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Since the oil crisis of 1973 the reduction of energy consumption has become one of the world's greatest common subject of study. In the steel industry also it has become an important theme of study. The rise in energy prices has direct bearing upon the steel manufacturing costs. Heating for hot working is a subject where much can be gained at present time by an exchange of information and experience between the scientist, plant engineer and production technologist. In providing an opportunity for such communication this volume, containing all the papers presented at the conference, has been published.

39125 **(DOE/BP/16112—T2) Industrial Test Program: SIC 2400 (wood products): Final follow-up report.** Vranizan, J. (Carroll, Hatch and Associates, Inc., Portland, OR (USA)). Mar 1986. Contract AC79-84BP16112. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012618.

Electrical energy is a small part of the cost of manufacturing wood products. Electrical costs represent approximately 2 to 3% of product selling price. A program that results in reducing electrical costs by 25% requires a major time commitment from management with a very modest impact on the income statement. It is not reasonable to expect these companies to do much conservation on their own. There is a significant amount of electrical energy available from conservation in the wood products industry. Other work estimate that 20 to 30 megawatts are available from dry kiln fan control. It is estimated there is at least that much available from controls on pneumatic conveying systems. Other miscellaneous sources should bring the total potential available to 100 megawatts. In order to take advantage of available potential conservation in the wood products industry, the industry will have to be shown on a step-by-step basis where and how the conservation measures are to be implemented. Implementation will have to be made attractive through the use of incentive programs that make economic sense to the individual mills. In dealing with a particular mill it is imperative to find or instill an attitude on the part of the plant manager that reflects belief in the concept of conservation or cost reduction by way of electrical energy use reduction.

39126 **(DOE/BP/18946—T3) Electrical energy conservation analyses of the Wood Products (SIC24) [Standard Industrial Code] Industry in the BPA service district: Mill summary report, Pope and Talbot Inc., Oakridge, Oregon.** (URS/TransEnergy Systems, Seattle, WA (USA)). 1985. Contract AC79-84BP18946. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012617.

There are opportunities for conservation which, when taken as a group, add up to a significant energy savings opportunity. However, there do not appear to be any single large conservation opportunities within the Pope and Talbot mill in Oakridge, Oregon. A few of the conservation measures identified have payback periods of less than two years and so would be attractive to Pope and Talbot. Many of the conservation measures have costs to the region, calculated by BPA-specified methods, below 52 mills/kWh and so would be attractive to BPA. None of the Energy Conservation Measures evaluated will impact mill production positively or negatively.

39127 **(DOE/BP/18946—T4) Electrical energy conservation analyses of the Wood Products (SIC24) [Standard Industrial Code] Industry in the BPA service district: Mill summary report, Pope and Talbot Inc., Port Gamble, Washington.** (URS/TransEnergy Systems, Seattle, WA (USA)). 1985. Contract AC79-84BP18946. 264p. NTIS, PC A12. File Number DE87012616.

There are a few potential opportunities for conservation which, when taken as a group, add up to a fairly significant energy savings opportunity. There do not appear to be any single large conservation opportunities within the mill. Only one of the conservation measures identified have payback periods of less than two years and so would be attractive to Pope and Talbot. A few of the conservation measures have costs to the region, calculated by BPA-specified methods, below 52 mills/kwH and so would be attractive to BPA. A review of electrical energy use per unit of production as a function of production indicates that it is fairly high. An opportunity to shift demand and reduce kW demand charges is available.

39128 **(DOE/BP/18946—T5) Electrical energy conservation analyses of the Wood Products (SIC24) [Standard Industrial Code] Industry in the BPA service district: Mill summary report, Northwest Hardwoods, Inc., Centralia, Washington.** (URS/TransEnergy Systems, Seattle, WA (USA)). 08 May 1985. Contract AC79-84BP18946. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012622.

As a result of an ongoing and aggressive electrical energy conservation program the remaining opportunities for conservation are limited. There are opportunities for conservation which, when taken as a group, may add up to a fairly significant energy savings opportunity. However, there do not appear to be any single large conservation opportunities within the mill. A few of the conservation measures identified have payback periods of less than two years and so may be attractive to Northwest Hardwoods. Some of the conservation measures have costs to the region, calculated by BPA-specified methods, below 52 mills/kWh and so would be attractive to BPA. Installation of variable speed fans in the kilns may meet BPA criteria and should be evaluated further. The cost and savings of some of the measures, such as replacement of electric personnel heaters and repair of compressed air leaks must be quantified on an individual opportunity basis. Motors that could be shut off during periods of low production may be left running.

39129 **(DOE/BP/18946—T6) Electrical energy conservation analyses of the Wood Products (SIC24) [Standard Industrial Code] Industry in the BPA service district: Mill summary report, Champion International Corp., Bonner, Montana.** (URS/TransEnergy Systems, Seattle, WA (USA)). 29 Apr 1985. Contract AC79-84BP18946. 315p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87012621.

There are opportunities for conservation which, when taken as a group, add up to a significant energy savings opportunity. However, there do not appear to be any single large conservation opportunities within the mill. A few of the conservation measures identified have payback periods of less than one year and so would be attractive to Champion. Many of the conservation measures have costs to the region, calculated by BPA-specified methods, below 52 mills/kWh and so would be attractive to BPA. None of the Energy Conservation Measures evaluated will impact mill production positively or negatively.

39130 **(DOE/CE/40539—01) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 1.0, Thermodynamic analysis.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). May 1984. Contract AC02-82CE40539. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009318.

This project is part of a longer-range program in which the objective is to establish a high efficiency prototype industrial power system that can burn coal directly. The power system consists of a slow-speed, two-stroke diesel engine and a fuel preparation system which provides clean micronized coal in a water slurry for use as the primary fuel. The project is divided into five tasks. This topical report is concerned with the subject of Task 1: Thermodynamic Analysis.

39131 **(DOE/CE/40539—03) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 3.0, Part 1, Single-cylinder engine test facility requirements and preparation; Part 2, Preliminary multi-cylinder prototype engine system development plan.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). Aug 1984. Contract AC02-82CE40539. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009320.

This project is part of a longer-range program in which the objective is to establish a high efficiency prototype industrial power system that can burn coal directly. The power system consists of a slow-speed, two-stroke diesel engine and a fuel preparation system which provides clean micronized coal in water slurry for use as the primary fuel. The project is divided into five tasks. This topical report is concerned with the subject of Task 3. Task 3 consists of two parts: (1) single-cylinder engine test facility requirements and preparation; and, (2) multi-cylinder prototype engine system development plan.

39132 **(DOE/CS/40419—T1) Energy savings by improved control of the finish grinding process in cement manufacture: Final report, January 1, 1985-December 31, 1986.** Weiss, S.J.; Tresouthick, S.W. (Construction Technology Labs., Skokie, IL (USA)). Mar 1987. Contract FC07-82CS40419. 176p. NTIS, PC A09/M1; 1; GPO Dep. File Number DE87012693.

Conventional closed-circuit ball mill systems for the finish grinding of portland cement produces product particle size distributions (PSDs) which indicate poor reduction of topsize and excessive production of fines. Optimization of ball mill systems should improve energy efficiency while meeting or exceeding typical cement performance requirements. Pilot scale continuous grinding systems, including a closed-circuit ball mill with a conventional classifier, a high-efficiency classifier, or a vertical roller mill were used to determine operating conditions and configurations which would lead to narrowing of the cement PSD. Closed-circuit ball mill results suggest that several opportunities exist to increase particle breakage efficiencies while minimizing unnecessary fines generation by means such as: modification of mill recirculation rates, optimal selection of ball size distribution, and use of highly efficient particle size classifiers. Mill system design philosophies common worldwide which favor long mill lengths, fine ball charges, and low circulating loads are called into question. In order to produce cements with acceptable early mortar strengths by sole use of a roller mill, products must be ground to finenesses similar to those of conventional cements.

39133 **(DOE/NBM—7012615) Industrial Test Program: Summary report on SIC [Standard Industrial Classification] 20, food processing.** (Seton, Johnson, and Odell, Inc., Portland, OR (USA)). 1 Apr 1985. 237p. NTIS, PC A11. File Number DE87012615.

In-depth electrical energy conservation studies were conducted at five food processing plants in the BPA region. Each study resulted in a report submitted to the industry and to BPA describing the major plant systems that use electrical energy and presenting specific recommendations for energy conservation measures to reduce the plant electrical consumption. Data from the five plant studies have been supplemented where appropriate with information from other energy studies in the food processing industry and with information from published sources. This document presents the following information: industry attitudes toward electrical energy conservation, corporate investment criteria for capital improvements to reduce energy consumption, the process used and steps taken to design a work plan for use in the energy studies, the steps in conducting the studies, the calculation procedures used to determine energy use patterns, energy savings, and installed costs for conservation measures, results of the energy studies, industry response to the study, and specific considerations for program design for industrial sector conservation programs.

39134 **(DOE/NBM—7012620) Energy conservation study on Smith Frozen Foods processing plant, Weston, Oregon.** (Seton, Johnson, and Odell, Inc., Portland, OR (USA)). 2 Jan 1985. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012620.

A comprehensive energy study was performed at Smith Frozen Foods in Weston, Oregon, in the fall of 1984. The plant processes corn, peas, lima beans and carrots. The products are inspected, prepared and graded before being sent through freeze tunnels. The frozen products are dumped into tote bins which are transported into cold storage warehouses. Energy conservation measures were calculated using a modified return on investment analysis called a return on capital (ROC) analysis and current rate schedules.

39135 **(DOE/NBM—7012624) BPA Industrial Test Program: SIC 26 report on the Northwest pulp and paper industry.** (EKONO, Inc., Bellevue, WA (USA)). 2 Aug 1985. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012624.

The Industrial Test Program identified forty energy conservation measures in the five participant mills. Most of the measures involved variable frequency drives or high efficiency motor retrofits. Others included lighting improvements, belt conveyors, regenerative unwind drives and oversized pump applications. All, except for seven lighting improvement evaluations, keyed on the major electricity consumer in pulp and paper operations, motors. The five mills were: Crown Zellerbach - Wauna Division, Longview Fibre Company, Port Townsend Paper Company, Publishers Paper -

Newberg Division, and Willamette Industries - Albany Mill Division.

39136 **(ED—115/151) Gas-fired immersion tube burners in a ceramic galvanising bath.** (Department of Energy, London (UK). Energy Efficiency Office; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; British Steel Corp., Rotherham. Swinden Labs.). Feb 1987. 46p. NTIS (US Sales Only), PC A03. File Number DE87752821.

In order to increase production levels and the efficiency of fuel utilisation, Tinsley Wire installed a new galvanising bath with a designed throughput capacity of 2.2 tonnes/hour on their No. 2 Factory Alloy Frame. The bath has several novel design features, the most important of which is the heating system, consisting of six self-recuperative burners of the type developed by the British Gas Corporation. The burners are fitted with single ended ceramic immersion tubes and offer the opportunity for improving energy efficiency and bath performance. The installation of the new bath has achieved reasonable annual savings for a capital cost of Pound 50,000. Savings of 1,400 GJ/year in specific energy consumption, worth Pound 4,300, and maintenance cost savings of about Pound 5,000/year, give the project a simple payback period of approximately 5 1/2 years.

39137 **(ED—119/183) Use of mechanical vapour recompression in the evaporation of skim milk. Final report.** (Department of Energy, London (UK). Energy Efficiency Office; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; National Industrial Fuel Efficiency Services Ltd., Altrincham (UK)). Mar 1987. 30p. NTIS (US Sales Only), PC A03. File Number DE87752819.

The installation and operational experience of a new mechanical vapour recompression (MVR) evaporator at the Dairy Crest Creamery at Kendal for the evaporation of skimmed milk are described. This project was assisted by the UK Energy Efficiency Demonstration Scheme. The MVR evaporator resulted in an 86% reduction in energy consumption and, when operating at the 1984/85 production level, the payback on the capital cost of the MVR system was 5.3 years.

39138 **(ED—121/126) Swarf drying and degreasing with minimum fuel requirements and emissions.** (Department of Energy, London (UK). Energy Efficiency Office; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Warren Spring Lab., Stevenage (UK)). Apr 1987. 27p. NTIS (US Sales Only), PC A03. File Number DE87752820.

Under the UK Energy Efficiency Demonstration Scheme, London and Scandinavian Metallurgical Co. Limited (LSM) has demonstrated at its Rotherham plant that titanium swarf can be dried and degreased in a new type of dryer employing heat recycling to the dryer drum. Energy consumption and fume emissions are reduced significantly with the new system. An estimated Pound 26,000/year is being saved with the new plant arrangement.

39139 **(EEO-ED—112-97) Performance of a waste heat recovery system for four gas-fired intermittent pottery kilns. A demonstration at A.G. Hackney and Co. Ltd. Final report .** (British Ceramic Research Association, Stoke-on-Trent; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Department of Energy, London (UK). Energy Efficiency Office). Jan 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752796.

Energy cost savings worth Pound 7,210/year have been achieved by the Burslem firm of A G Hackney and Co Ltd as a result of installing a waste heat recovery system on four intermittent kilns. A plate heat exchanger was installed in the combined exhausts from a battery of four gas-fired intermittent kilns. The demonstration showed that sufficient heat was recovered from the kilns to provide all the heating requirements of two nearby driers and to increase the temperature in a third. There were no adverse effects on the quality of the ware produced. The system cost Pound 30,820 to install in 1981 and the net cost savings achieved gave a payback period of just over four years.

39140 **(EEO-ED—114-142) Assessment of heat recovery systems in the wool textile industry. Final report.** (WIRA, Leeds (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit; Department of Energy, London (UK). Energy Efficiency Office). Jan 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752798.

The Wool Industry Research Association, WIRA, under contract with the Energy Efficiency Office, of the Department of Energy, examined the performance of 19 existing heat recovery systems in order to assess their performance and to comment on their cost effectiveness. The systems examined serve the wool and worsted sectors of the industry and cover dryer, liquid effluent and boiler flue gas heat recovery. It is concluded that heat recovery can be a highly cost effective means of reducing expenditure on energy in many areas of the textile and allied industries.

39141 **(EEO-ED—116/166) Solar-assisted curing of concrete block. A demonstration of Tarmac Topblock. Final report.** (Department of Energy, London (UK). Energy Efficiency Office; Ove Arup and Partners, London (UK)). Mar 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752802.

A description is given of a recently installed, solar assisted, thermally insulated curing enclosure at a concrete block plant as part of the UK Energy Efficiency Demonstration Scheme. Although the curing time has increased from 3-4 hours to 48-72 hours, the fuel requirement for the old steam curing system has been completely eliminated. A reduction of 85% in energy consumption per cubic metre of blocks produced has resulted in a payback period of 2.74 years.

39142 **(EEO-ED—118/169) Fast, once firing of glazed earthenware hollow-ware. A demonstration project at Churchill Tableware Ltd., Stoke-on-Trent. Final report.** (Department of Energy, London (UK). Energy Efficiency Office; British Ceramic Research Association, Stoke-on-Trent). Mar 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752801.

The introduction of a single-layer, fast-fire car tunnel kiln at a glazed earthenware factory is described as part of the UK Energy Efficiency Demonstration Scheme. The natural gas-fired kiln is of modular design with low density insulating bricks and ceramic fibre and is capable of producing the same quality of mugs and cups from once-firing as were previously produced from twice-firing. The payback period is 1.8 years.

39143 **(EEO-ED—120/176) Flat flame burner on an aluminium melting and holding furnace. A demonstration at Alycast Ltd. [Telford (GB)]. Final report.** (Department of Energy, London (UK). Energy Efficiency Office; Mapplebeck (John E.) Ltd., Birmingham (UK)). Mar 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752800.

The installation of a flat flame burner furnace at a pressure diecasting foundry as part of a UK Energy Efficiency Demonstration Project is described. The new furnace has a higher thermal efficiency, requires reduced maintenance and has increased operational flexibility compared to conventional furnaces. The energy savings are such as to achieve a payback period of six months. Suggestions for future improvements are also included.

39144 **(ETSU-B—1124) Detailed investigation into possible ways of achieving heat recovery from anaerobic digestion effluent. Final report.** Murad, A.M.A. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 69p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

This report describes an investigation of the possible methods which are capable of recovering the low grade energy associated with anaerobic digestion effluents. Different methods of heat recovery have been assessed but due to the high solid contents associated with these effluents, the simple double pipe but corrugated heat exchanger was considered to be the most suitable. A full economic appraisal was not possible owing to the lack of physical

property and heat transfer coefficient data which are necessary when designing any heat recovery equipment.

39145 **(EUR—9931) Development of microwave applicators to dry thin structures.** Luypaert, P.J. (Commission of the European Communities, Luxembourg). 1985. 23p. NTIS (US Sales Only), PC A02. File Number DE87751795.

The research project was directed to the study and development of a microwave applicator for drying and treating thin planar layers and adaptable for different layers material. Computer calculation of the power distribution in the layer led to the construction of a microwave applicator with horizontal directed $\lambda/4$ dipoles. In this applicator the materials are heated homogeneously. A practical application is the plastification of paper with a PVDC sheet. The PVDC emulsion contains 55% solid material and 45% water, which has to be evaporated. Drying with microwave energy instead of using hot air and infrared radiation, results in an energy saving up to 20%.

39146 **(IFP—32-765) Electric power development prospects for oil refining.** Elzir, A. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). 25 Jan 1985. 246p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752670.

Energy consumption of a petroleum refinery, using electric energy, is evaluated up to the year 2000. Then refining evolution is examined by mathematical models for evaluation of the electrification of some operations. A birefinery model is elaborated for traditional conversion (catalytic cracking + visbreaking) and deep conversion (traditional + deasphalting or cocking). The result shows, for the year 2000, that electricity consumption amounts to less than 8% of total energy requirements of French refineries. For a more important development electric ovens and vapor mechanical recompression should be introduced in refineries.

39147 **(NP—7770094) Investigations of new foil greenhouse concepts.** Weimann, G. (Hannover Univ. (Germany, F.R.). Inst. fuer Technik in Gartenbau und Landwirtschaft). 1986. 170p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770094.

The paper compares the different foil greenhouse concepts regarding their permeability to light, air humidity, condensate on the envelope surface, CO/sub 2/ characteristics, heat consumption and economy. The designs were developed from a catalogue of requirements. The catalogue of requirements which was compiled was used for the identification of errors and as a stimulus for new developments.

39148 **(NP—7770249) Energy-conserving and raw materials-saving production processes. Project results. July 1, 1983-December 31, 1985.** (Technische Hochschule Aachen (Germany, F.R.). Sonderforschungsbereich 144 - Methoden zur Energie- und Rohstoffeinsparung fuer Ausgewaehite Fertigungsprozesse). 1985. 229p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770249.

The report abstracted presents the results of a project dedicated to researching into casting and moulding processes (part A), forming (part B), forming/parting (part C) and jointing processes (part D) characterizing fabrication processes, i.e. the development from unmachined parts to the end product. Moreover, the project investigates into driving and control systems (part E) and materials/design and construction/substitution (part F) applying to all of the processes dealt with. The following project titles are a choice of the subjects discussed: globulitic solidification of cast metals on the basis of Fe, Ni and Co after intermittent investement casting processes and continuous rheocasting; light-weight semifinished products with directional fiber reinforcement in plastic matrices - an energy-conserving process; analysis of production processes in the case of ring-shaped products with particular regard to optimization; extending the uses of sheet metal work pieces; shielded arc/narrow gap welding and the joining of thick-walled components; low-loss power draw from a constant voltage generator; substitution criteria for different processes and materials. (HWJ).

39149 **(NP—7770250) Waste heat recovery from metallurgical slag.** Lindner, K.H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 4 Apr 1986. 282p. (In German). NTIS (US Sales Only), PC A13. File Number DE87770250.

The high heat losses in the different stages of the steel production process offer a wide field for energy conservation. A proposal was developed in the course of a BMFT project. The proposed process is based on pilot plant experiments on heat recovery from liquid metallurgical slag via radiative and conductive heat transfer (1st stage) and on the computer simulation of a slag cooling shaft (2nd stage). Heat is recovered from the slag in two stages, i.e. in the liquid and solid phase. The two-stage process is indispensable for economic efficiency if a marketable material for road construction is to be the end product.

39150 **(PNL—6160) Empirical impact evaluation of the energy savings resulting from BPA's Stage II irrigation system retrofit program: Final report.** Harrer, B.J.; Tawil, J.W.; Lyke, A.J.; Nieves, L.A.; Edin, E.S.; Bailey, B.M. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013219.

This report documents the results of an evaluation of the impacts on irrigation system energy consumption of conservation measures installed under the Bonneville Power Administration's Stage II retrofit program. Historical billing data and other farm records provided the basis for this evaluation. A number of different statistical techniques were used to estimate the actual energy savings resulting from the Stage II conservation measures. Results of the study reveal that the methodology used in predicting energy savings resulting from the Stage II program is accurate. The basis for energy savings predictions in the Stage II program are changes in brake horsepower, and, in this study, a 1% change in brake horsepower was found to result in slightly more than a 1% change in energy consumption. Overall, Stage II program conservation measures were found to reduce irrigation system energy use by an average of 34%. The average costs of obtaining these savings were 6 mills (.6 cents) per kWh saved.

39151 **The effect of lighting system components on lighting quality, energy use, and life-cycle cost.** Rubinstein, F.M.; Clark, T.A.; Siminovitch, M.J.; Verderber, R.R. (Lawrence Berkeley Lab., 1 Cyclotron Road, Mail Stop 46-125). pp 1685-1689 of The IEEE 1986 Industry Applications Society 21st annual meeting (Conference Record). Piscataway, NJ; IEEE Service Center (1986). (CONF-860903—). Contract AC03-76SF00098.

From IEEE-Industry Applications Society annual meeting; Denver, CO, USA (28 Sep 1986).

A computational method was developed to examine the effect of lamp, ballast, and fixture selection on the quality and quantity of illumination, energy consumption, and life-cycle cost of lighting systems. Applying this analysis to lighting layouts using different lamp/ballast/fixture combinations suggested that combinations with higher lumen outputs reduced the uniformity of the illuminance distribution at the workplane but did not reduce visibility levels. The use of higher lumen output lamp/ballast/fixture systems and higher efficiency components tended to reduce life-cycle costs as long as the premium cost of the components was not too high.

39152 **The effects of fixture type and HVAC integration on fluorescent lamp/ballast performance.** Siminovitch, M.J.; Rubinstein, F.M.; Verderber, R.R.; Clark, T.A. (Lighting Systems Research Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1680-1684 of The IEEE 1986 Industry Applications Society 21st annual meeting (Conference Record). Piscataway, NJ; IEEE Service Center (1986). (CONF-860903—). Contract AC03-76SF00098.

From IEEE-Industry Applications Society annual meeting; Denver, CO, USA (28 Sep 1986).

This paper describes the effects of fixture type and lamp compartment air extract characteristics on lamp/ballast performance. A luminaire/plenum/HVAC simulator was used to measure

minimum lamp wall temperature inside four fixture types while varying lamp-compartment extract conditions. Experimental data show that the lumen output of the lamp/ballast system varies by 20% and system efficacy by 10%, depending on the type of fixture and lamp-compartment extract technique employed.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 38711, 38720, 39027, 39044, 39112, 39113, 39114, 39117, 39472, 39570

39153 **(BMFT-FB-T—86-172) Development of a vacuum insulated district-heating pipe. Final report.** Schilf, L.; Giese, I.H.; Haupt, U.; Klose, H.; Wachsmuth, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Messerschmitt- Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Energie- und Prozesstechnik). Dec 1986. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770245.

An adaption development of vacuum-super-insulated pipes (VSI pipes) was made for district-heating applications. Central themes of this project were: Construction of a gap between two adjacent pipes and the thermical behaviour at this area, the possibility of production by the MBB-technology for powder-filling and -compression was analyzed and various welding methods were proofed for qualification. The economical advantages depending on reducing the energy losses and needing no features for length compensation are shown. With 57 figs.

39154 **(CONF-870620—7) Optimal energy transmission fluids for district heating and cooling applications.** Kasza, K.E.; Choi, U.S.; Kaminsky, J. (Argonne National Lab., IL (USA); USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Conservation, Buildings, and Community Energy Systems). May 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011449.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting; Nashville, TN, USA (28 Jun 1987).

The US Department of Energy is sponsoring the development of improving energy transmission fluids for district heating and cooling applications. This long-range-program has as its objectives: (1) identifying and developing high performance thermal-hydraulic energy transmission fluids and the components to best utilize the fluids in DHC systems; (2) demonstrating that these fluids substantially reduce frictional losses and improve heat transfer, resulting in the ability to use smaller piping, pumps, heat exchangers, and storage tanks; and (3) generating friction and heat transfer correlations and system performance information needed for design of improved DHC systems.

39155 **(CONF-870621—2) Evaluation of acoustic leak detection technology for district heating systems application.** Kupperman, D.S.; Karvelas, D. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011446.

From 78. International District Heating and Cooling Association conference; Baltimore, MD, USA (21 Jun 1987).

Recent advances in commercially available acoustic sensors and signal processing have made acoustic detection of gas and fluid leaks cost-effective and efficient. As a result, a variety of industries are beginning to use acoustic leak detection systems. This report describes a DOE funded effort at Argonne National Laboratory to obtain laboratory-generated data to establish the effectiveness of an advanced acoustic leak detection system for finding, locating, and sizing leaks in district heating (DH) piping systems. The results of experiments carried out with DH insulated piping suggest that acoustic leak detection technology can be applied effectively to monitor, locate, and detect leaks in underground piping. Leak monitoring can be carried out with appropriately spaced acoustic sensors placed either on the pipe or on the ends of acoustic waveguides in contact with the pipe. Acoustic detection of leaks less than 10 gpm is possible in underground DH pipes. With advanced signal processing and sensors, the range of detection for steam leaks could be greater than 500 m and the location accuracy a few meters. Acoustic background noise and attenuation data from field pipes are required to accurately establish leak detection sensitivity and leak location.

39156 **(CONF-870816—23) Pressure drop and heat transfer in turbulent non-Newtonian slurry pipe flow of advanced energy transmission fluids.** Choi, U.S.; Krazinski, J.L.; Kasza, K.E. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011458.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

Many thermal systems are characterized by long runs of piping which convey a pumped energy transmission fluid between the sources and sink heat exchangers of the system. Furthermore, these systems often operate with small temperature differences, so it requires that large volumes of fluid must be pumped and large exchangers must be used to satisfy load demands. In order to improve the performance of these thermal systems, Argonne National Laboratory is developing Advanced Energy Transmission Fluids based on the following two concepts: (1) utilization of very low concentrations (20-200 wppm) of non-Newtonian additives to the appropriate carrier liquid to reduce frictional flow losses by 30-80%; and (2) utilization of a pumpable phase change slurry comprised of particulates of a high heat of fusion material conveyed by a liquid to enhance both bulk convective energy transport and heat transfer coefficients at heat exchanger surfaces. One example of candidate particles is cross-linked form-stable high-density polyethylene (X-HDPE).

39157 (CONF-8511291—, pp 122-142) **Potential of energy generation from the biomass contained in domestic refuse.** Thome-Kozmiensky, K.J. Nov 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770134.

From Experts' meeting on energy from biomass - experience gained with various technical solutions and prospects for the future; Freising, F.R. Germany (18 Nov 1985).

Energy can be generated from domestic refuse mainly by thermal treatment processes - degassing, gasification and incineration. Production of gas from landfills is an evitable result of correct landfill management and is not implemented just for energy production. Domestic refuse and comparable industrial wastes differ from conventional fuels in as much as they have a heterogeneous composition in terms of piece size and calorific value which, together with time-dependent quality variations, render the management of the combustion process more difficult. That is why stoichiometric quantities of air in great excess have to be supplied which require large dimensioning of the combustion chamber and downstream units and reduce the efficiency. Safe prevention of dioxin emissions has been the focus of activities especially in recent times. Possible methods consist in increasing combustion chamber temperature and residence time of flue gases. In addition, recirculation of a part of the flue gases is a promising method for optimizing and controlling the combustion process. Flue gas recirculation allows to modify the temperatures, volume flows and concentrations of the gas components involved in combustion. Wastes are predried, the combustion chamber temperature is reduced, chemically bound energy is released and controllability in partial-load operation is improved in dependence from the management of the recirculating gases.

39158 **(EPRI-EM—5285) Proceedings: 1986 EPRI cogeneration symposium.** Limaye, D.R. (Synergic Resources Corp., Bala-Cynwyd, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 251p. (CONF-8610300—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920505.

From EPRI cogeneration symposium; Washington, DC, USA (14 Oct 1986).

On October 14-15, 1986, EPRI sponsored a Symposium on cogeneration to examine the major issues of current interest to utilities. The Symposium, held in Washington, DC, provided a forum for the review and exchange of information on the recent cogeneration experiences of utilities. Specific topics discussed were federal

cogeneration regulations and their impacts on utilities, cogeneration trends and prospects, utility leadership in cogeneration ventures, strategic utility planning relative to cogeneration, small cogeneration: implications for utilities; and electric alternatives to cogeneration. Some of the critical issues relative to cogeneration from the utility perspective were explored in case studies, discussions and question/answer sessions. This report contains the 24 papers presented and discussed at the Symposium. They are processed separately for the data base.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

39159 **(N—87-20382) Arcjet component conditions through a multistart test.** Curran, F.M.; Haag, T.W. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 20p. (NASA-TM—89857; E—3525; NAS—1.15:89857; AIAA—87-1060; CONF-870558—3). NTIS, PC A02/MF A01.

From 19. international electric propulsion conference; Colorado Springs, CO, USA (11 May 1987).

A low power, dc arcjet thruster was tested for starting reliability using hydrogen-nitrogen mixtures simulating the decomposition products of hydrazine. More than 300 starts were accumulated in phases with extended burn-in periods interlaced. A high degree of flow stabilization was built into the arcjet and the power supply incorporated both rapid current regulation and a high voltage, pulsed starting circuit. A nominal current level of 10 A was maintained throughout the test. Photomicrographs of the cathode tip showed a rapid recession to a steady-state operating geometry. A target of 300 starts was selected, as this represents significantly more than anticipated (150 to 240), in missions of 10 yr or less duration. Weighings showed no apparent mass loss. Some anode erosion was observed, particularly at the entrance to the constrictor. This was attributed to the brief period during startup the arc mode attachment point spends in the high pressure region upstream of the nozzle. Based on the results obtained, startup does not appear to be performance or life limiting for the number of starts typical of operational satellite applications.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 39163, 39164, 39165, 39166, 39167, 39168, 39169, 39170

39160 **(AD-A—179826/3/XAB) Measurements of instantaneous heat flux to metal and ceramic surfaces in a diesel engine.** Huang, J.C.; Borman, G.L. (Wisconsin Univ., Madison (USA)). Feb 1987. 19p. NTIS, PC A02/MF A01.

Pub. in International Congress and Exposition, 137-152, 23-27(Feb 1987).

The effects of surface materials and extent of insulation on the heat transfer to the head of an open-chamber diesel were studied. A large instrumentation plug designed to incorporate plates of various materials on the gas-side surface was utilized with a special research head. Instantaneous rates of heat transfer to the plate gas-side surface were measured. Measurement results obtained with a zirconia plate and an insulated metal plate are compared to data for an inunsulated metal plate. The insulation of the metal plate increased its gas-side surface temperature over the uninsulated case by about the same amount achieved with a 6.35-mm-thick zirconia plate. The magnitude of the surface temperature swing for zirconia is not as high as expected from conduction theory, but is substantially higher than that for the uninsulated metal. Significant reductions of steady-state heat fluxes were achieved with both the zirconia and the insulated metal compared to the uninsulated metal.

3303 Electric-powered Systems

39161 **(CONF-8610122—) VIII international electric vehicle symposium.** (USDOE, Washington, DC; Edison Electric Inst., New York (USA); Electric Power Research Inst., Palo Alto, CA (USA); Electric Vehicle Development Corp., Cupertino, CA (USA)). 1986. 539p. NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE87010697.

From 8. international electric vehicle symposium; Washington, DC, USA (20 Oct 1986).

The proceedings from the symposium are presented. Major topics discussed include: battery technology, powertrains; hybrid vehicles, marketing and economics, propulsion, and electric vehicle design and performance. Each paper has been separately indexed for inclusion in the Energy Data Base.

3306 Vehicle Design Factors

39162 **(NP—7770151) Exhaust gas catalyst, its construction, function and effect.** Buck, D. (Opel (A.) A.G., Ruesselsheim (Germany, F.R.)). Dec 1984. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87770151.

Vehicular traffic is responsible for 75% of lead contamination of the atmosphere, 3.4% of sulphur dioxide, 54.6 of nitrogen oxide and 65% of carbon monoxide. The petrol engine also emits hydrocarbons, apart from the above noxious substances. Details are given of the various emissions of noxious substances, in order to deal with the reduction of these by the catalyst. The term 'catalyst' and the special features of the various catalyst systems, such as single bed oxidation, double bed and single bed three-way catalysts are explained. The ceramic and metal monolith catalyst are introduced with schematic diagrams. The advantages and disadvantages of the individual catalyst systems are mentioned and lambda regulation and the problems of catalyst techniques (the effect on consumption and output, efficiency factors) are explained. The expensive technique of catalysts is emphasized. Different test processes and regulations in Japan, the USA and the EEC are finally listed. (HWJ).

3307 Emission Control

REFER ALSO TO CITATION(S) 39162, 39573

39163 **(PB—87-141644/XAB) Application for certification 1987 model year heavy-duty engines - Navistar International Corporation.** (Navistar International Corp., Melrose Park, IL (USA)). 1987. 94p. NTIS PC$23.00/MF$16.50.

See also PB—87-141636; Also available in set of 4 reports PC E99, PB—87-141602.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39164 **(PB—87-141669/XAB) Application for certification 1987 model year light-duty vehicles - Austin Rover.** (Austin Rover Group Ltd., Miami, FL (USA)). 1987. 204p. NTIS PC$31.50/MF$16.50.

See also PB—87-141677; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed mainte-

nance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39165 **(PB—87-141701/XAB) Application for certification 1987 model year light-duty vehicles - Jaguar.** (Jaguar Cars, Inc., Leonia, NJ (USA)). 1987. 98p. NTIS PC$23.00/MF$16.50.

See also PB—84-124460, PB—87-141693, and PB—87-141719; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39166 **(PB—87-141719/XAB) Application for certification 1987 model year light-duty vehicles - Land Rover Ltd.** (Land Rover Ltd., West Midlands (UK)). 1987. 117p. NTIS PC$24.50/MF$16.50.

See also PB—87-141701, and PB—87-141727; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39167 **(PB—87-141727/XAB) Application for certification 1987 model year light-duty vehicles - Mazda.** (Mazda Motor Corp., Hiroshima (Japan)). 1987. 772p. NTIS PC$77.00/MF$17.50.

See also PB—85-136554, PB—87-141719, and PB—87-141735; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39168 **(PB—87-141750/XAB) Application for certification 1987 model year light-duty vehicles - Peugeot.** (Peugeot Motors of America, Inc., Lyndhurst, NJ). 1987. 1723p. NTIS PC$158.00/MF$20.50.

See also PB—85-136596, PB—87-141743, and PB—87-141768; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39169 **(PB—87-141784/XAB) Application for certification 1987 model year light-duty vehicles - Saab.** (Saab-Scania of America, Inc., Orange, CT). 1987. 514p. NTIS PC$56.50/MF$16.50.

See also PB—85-136604, PB—87-141776, and PB—87-141792; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

39170 **(PB—87-172367/XAB) Application for certification 1987 model year light-duty vehicles - Mazda.** (Mazda Motor Corp., Hiroshima (Japan)). 1987. 277p. NTIS PC$37.50/MF$16.50.

See also PB—87-172359 and PB—87-141727; Also available in set of 2 reports PC E99/MF E99, PB—87-172342.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 38693, 38713, 38714

39171 **(ETSU-R—33) Ranking of synthetic fuel options for road transport applications in the UK.** Langley, K.F. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Apr 1987. 91p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The relative technical and economic merits of various synthetic fuels for road transport applications in the UK over the period up to the year 2005 and beyond are assessed. The main feed-

stocks which are available for conversion to synthetic fuel are: residual fuel oil from crude oil refining; unconventional oil sources such as very heavy crudes, tar sands and oil shales; coal; natural gas and petroleum gases, and biomass in the form of organic wastes or crops grown specifically for energy purposes. In addition, electricity from nuclear power or renewable sources is considered as a resource which can be utilised by electrochemical means. The cost of producing the various synthetic fuels is determined. The technical characteristics required of synthetic fuels are examined, and the extent to which a given feedstock/synthetic fuel option is likely to make a significant contribution to future road transport fuel requirements is assessed.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 40277

39172 **(AD-A—179937/8/XAB) Arms control - ripe for change. Student report.** Westbrook, C.R. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1987. 25p. (ACSC—87-2705). NTIS, PC A02/MF A01.

The challenge of the eighties is to determine and implement modifications that will allow the arms-control process to reach full effectiveness as a peacekeeping tool. This article briefly discusses what is right and wrong with the current process and then presents three modifications that could be implemented to meet that challenge. The modifications include mission-based accounting, confidence-building measures, and a weapons test ban. Pro and con arguments are given for each but the emphasis of the article is on revitalizing the arms-control process so that meaningful treaties can be produced in the future.

39173 **(AD-A—179967/5/XAB) Soviet Union's foreign policy environment to the year 2000. Final report, 13 January-23 February 1987.** Rubinstein, A.Z. (Pennsylvania Univ., Philadelphia (USA)). 23 Feb 1987. 30p. NTIS, PC A03/MF A01.

The advent of the Gorbachev era invites comparision with the Khrushchev era years ago. Both leaders were confronted by major domestic and foreign policy problems, dilemmas, and choices. The similarities are striking: the struggle for power at a time of mounting economic and political dilemmas; the quest for rationalization of Soviet-East European economic relationships, subject to Moscow's continued control; the need to improve relations with the United States; the readiness to pursue Soviet objectives in the Third World irrespective of their adverse consequences for Soviet-American relations. The differences are significant and intensify Gorbachev's problem: Gorbachev's USSR is far stronger than Khrushchev's and is a credible nuclear power; Gorbachev has many more options in the Third World; the Far East is a major foreign policy issue; and U.S. influence in the international system is less in the 1980s than it was in the 1950s. The thrust of this analysis is toward essential continuity in the decade or so ahead. The Kremlin is confronted with growing domestic problems, but in foreign policy the following aims seem likely: preservation of the imperial system in Eastern Europe; improved relations with the United States, including arms control agreements if possible; normalization of ties with China and Japan; and competitive rivalry with the United States in the Third World.

3502 Proliferation

39174 **(AD-A—179827/1/XAB) Training implications of directed energy weapons for the US Army: a preliminary report. Final report, September 1983-September 1984.** Bayer, G.C. (Litton Systems, Inc., Fort Walton Beach, FL (USA). Mellonics Systems Development Div.). Oct 1986. 109p. NTIS, PC A06/MF A01.

This report addresses the need to fill information gaps in training and doctrine on directed energy. A comprehensive presentation of nonclassified descriptions of directed-energy types, employment possibilities, and appropriate countermeasures serves as the major portion of this report. Directed-energy proliferation on the battlefield is a critical issue faced by commanders and soldiers alike. The results of a pilot test suggest that relatively simple training that can minimize directed-energy-weapon effectiveness on individual and crew performance can be developed and presented to soldiers. A closing issue is discussion of directed energy to generate widespread understanding of directed-energy effects and capabilities and the need to reconsider the classification level of some information. A large body of directed-energy information is currently held as sensitive when in fact it could be made available to concerned field commanders and trainers in general format. Specified classified details could easily remain sensitive while the release of common knowledge would permit trainers to develop comprehensive responses to the directed-energy threat.

39175 **(AD-A—180003/6/XAB) Strategic ASW and the conventional defense of Europe. Professional paper.** Dismukes, B. (Center for Naval Analyses, Alexandria, VA (USA)). Apr 1987. 31p. (CNA-PP—453). NTIS, PC A03/MF A01.

Leaders in the US Navy have recommended that the United States seriously consider the option of attacking Soviet ballistic missile submarines during the conventional phase of a major war arguing that in, so doing, the U.S. and its allies could gain strategic leverage over the USSR and aid in war termination on terms acceptable to the US and our allies. They argue further that antisubmarine warfare is small because what is happening ashore, not at sea, would dominate any Soviet decision to fire nuclear weapons. Critics of this policy in the US have vigorously argued the contrary, asserting variously that: attacking Soviet SSBNs would produce little advantage because SSBNs make up only a small fraction of Soviet strategic forces; or the risk of escalation would be unacceptably high because the Soviets would feel significant pressure to rectify the NUCLEAR BALANCE with a counterforce strike ON THE U.S.. At its worst, critics argve, a calculated strategic ASW campaign by the U.S. would encourage the Soviets to attack preemptively because they would see it as little other than a precursor to a surprise U.S. attack on Soviet ICBMs and intercontinental bombers. This paper examines these and other arguments and presents his conclusions as to how they affect the conventional defense of Europe.

3503 Verification

REFER ALSO TO CITATION(S) 39556, 39557, 39558, 39559, 39560, 39591

39176 (INIS-mf—10632, pp 214) **Step plan for the realization of a seismic monitoring system for a nuclear test stop.** Harjes, H.P.; Henger, M. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

36 MATERIALS

REFER ALSO TO CITATION(S) 39363

39177 **(SAND—87-0668C) Pressure-shear loading of materials.** Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 20 Jul 1987. Contract AC04-76DP00789. 7p. (CONF-870753—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012134.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Although plate impact techniques provide a unique capability for determining the dynamic properties of materials at high pressures and strain rates, these investigations are limited to studies of material response under uniaxial strain loading. The development of pressure-shear loading techniques has greatly enhanced the potential of studying material response under more general loading

conditions, which is possible because of the capability to measure in-plane motions in a dynamically precompressed material with a variety of time-resolved techniques. The lack of such tools had hampered the implementation of pressure-shear loading techniques proposed almost three decades ago. One-dimensional pressure-shear loading techniques are briefly described, and the capabilities these techniques have provided in the study of dynamic material response are illustrated by several examples.

39178 (UCRL—96493) Computer simulations of the explosive consolidation of powders. Reaugh, J.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—35). NTIS, PC A02. File Number DE87012626.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

We have used computer simulations to study the explosive consolidation of powders in various experimental configurations. The objectives of these studies are (1) to help design experimental geometries that permit recovery of dense, consolidated powders, and (2) to help understand why failures occur in other geometries. We present results of our computer simulations of the geometries used by various experimenters for the consolidation of tungsten powder into rods, aluminum nitride powder into tubes and diamond powder into disks. We show that the stress histories experienced by the powders in these geometries are qualitatively different.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 38429, 38430, 38568, 38687, 38756, 38817, 38833, 38842, 38862, 38868, 38871, 38872, 38946, 38958, 38979, 38981, 39259, 39371, 40184, 40234, 40235, 40236, 40237, 40238, 40239, 40240, 40241, 40242, 40243, 40244, 40245, 40246, 40247, 40248, 40249, 40250, 40251, 40252, 40253, 40254, 40255, 40256, 40257, 40258, 40259, 40260, 40261, 40262, 40263, 40264, 40265, 40268, 40270, 40270, 40271, 40271, 40272, 40273

39179 (AD-A—179794/3/XAB) Laser cladding of Ni+Cr+Al+rare earth alloys for improved oxidation and hot corrosion. Annual progress report, November 1985-November 1986. Mazumder, J.; Kar, A.; Singh, J. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Nov 1986. 136p. NTIS, PC A07/MF A01.

Alloys and coatings for alloys for improved high-temperature service life under aggressive atmosphere are of great contemporary interest. There is a general consensus that addition of reactive elements such as hafnium will provide many beneficial effects for such alloys. The laser-cladding technique was used to produce nickel-iron-chromium-aluminum-hafnium alloys. The laser cladding technique was used to produce Ni-Fe-Cr-Al-Hf alloys with extended solid solution of Hf. A 10-kW carbon dioxide laser with mixed powder feed was used for laser cladding. Optical, scanning electron microscopy (SEM) and scanning transmission electron (STEM) microscopy were employed for microstructural evolution of alloys produced during laser cladding processes. The electron probe microanalysis and the auger electron spectroscopy were also used for microchemical analysis of different phases. Microstructural studies revealed a high degree of grain refinement, considerable increase in solubility of Hf in matrix and Hf-rich precipitates and new metastable phases. The microstructural development in this laser clad Ni-Fe-Cr-Al-Hf alloy is reported.

39180 (AD-A—179808/1/XAB) Precipitation and Ostwald ripening in dilute Al base-Zr-V alloys. Zedalis, M.S.; Fine, M.E. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). Dec 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Metallurgical Transactions A, Vol. 17A, 2187-2198(Dec 1986).

The coarsening rates of both cubic and tetragonal aluminum zirconium precipitates in aluminum were measured. The tetragonal Al_3Zr coarsened 16 times faster than the cubic modification in keeping with the fact that the latter is coherent and coplanar with the matrix while the former forms a semi-coherent interface with the matrix giving a larger interfacial energy. Partial substitution of vanadium zirconium reduced the precipitate-matrix mismatch for both phases and slowed both coarsening rates as well as retarded the cubic-to-tetragonal transformation. Reducing strain and interfacial energy no doubt is the origin of this effect. Since the cubic particles are spherical, their volume fraction is small and the coherency strains are small: this would appear to be an ideal system for testing the Lifshitz-Sylozov-Wagner theory of diffusion-controlled Ostwald ripening. While the theory seems to hold, the calculated diffusivity of Zr in Al is much higher than the value reported in the literature. Because of the low coarsening rates of the dispersed particles, the aluminum-zirconium-vanadium system shows promise as the basis for a high-temperature Al alloy.

39181 (BMFT-FB-T—86-139) Influence of diffusible hydrogen on the development of cracks in fine-grained high-strength steels during welding. Final report. Faerber, M.G.; Langenbahn, H.W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Schweisstechnische Fertigungsverfahren). Dec 1986. 129p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-07938.

Base metal and weld metal absorb hydrogen during welding by several bonding processes, which may induce brittle fracture. Development of brittle fracture may be supported by heat treatment, when, depending on temperature, hydrogen becomes diffusible again, may concentrate locally and thus reduce yield strength. The diffusible hydrogen content in tension and bending specimens can be investigated analytically in a Hydrogen-Assay-Recipient under stress and a stress-relief temperature of 873 K. The specimens were taken from the HAZ of several weld joints, 20 MnMoNi 55, 15 MnNi 6 3, StE 690. The sheets were welded by field-proven values by submerged arc welding, stick electrode welding, gas shielded metal arc welding, and electroslag welding. Some specimens were annealed at 523 K for 5 hours to reduce hydrogen content. A rule of precedence was found for the welding processes, referring to their hydrogen loading. The values of contraction in area were taken on the destructive test. They seemed to be good critical for local hydrogen-induced texture separations, which were demonstrated by scanning electron microscopy of the surface of fracture. Different hydrogen contents induced brittle texture separations in different dimension. With 100 refs., 7 tabs., 62 figs.

39182 (BNL—40004) De-alloying. Sieradzki, K.; Newman, R.C.; Shahrabi, T. (Brookhaven National Lab., Upton, NY (USA); University of Manchester Inst. of Science and Technology (UK). Corrosion and Protection Centre). 1987. Contract AC02-76CH00016. 19p. (CONF-870658—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012488.

From International conference on localized corrosion; Orlando, FL, USA (1 Jun 1987).

Recent advances in the atomistic theory of de-alloying are outlined, together with electrochemical considerations such as near-equilibration of the noble alloy component with occluded environments. The best description of dealloying is a percolation process modified by surface diffusion, site-dependent dissolution, and possibly exchange-current surface restructuring.

39183 (CEA-CONF—8849) Graphic classification of main mode of hydrogen action on mechanical behavior of metals. Relationship with the Mendeliev Periodic System. Fidelle, J.P.; Aucouturier, M. (CEA, 75 - Paris (France)). Oct 1986. 12p. (In French). (CONF-8609273—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752195.

From 1. Franco-Argentin symposium on materials science; Mar del Plata, Argentina (29 Sep 1986).

Hydrogen effects on metals are evidenced in a fast a simple way. Experimental results show the sensitiveness of A metals of the Mendeliev Periodic System to dissolved hydrogen embrittlement and/or hydride effects; B metals are not sensitive, except if they are alloyed with A metals. It is shown how B metals and semimetals can intervene in hydrogen embrittlement of A metals. Embrittlement by gas bubbles under pressure can affect hydridable metals.

39184 **(CEA-CONF—8914) PWR steam generator tubes. Corrosion in primary coolant circuit. Evolution of knowledge.** Pinard Legry, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques). Dec 1986. 13p. (In French). (CONF-861262—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752642.

From SFEN conference on fast reactors and the startup of superphenix; Paris, France (10 Dec 1986).

Cracks can occur in nickel rich austenitic alloys in pure water at 350/sup 0/C after few months. Influence of composition, microstructure stresses, corrosive effect of the medium, hydrogen embrittlement and temperature dependence on stress corrosion of alloy 600 are studied. A model is presented for the mechanism of crack formation.

39185 **(CONF-870719—1) The morphology of low temperature phase transformations in the iron-chromium system.** Miller, M.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011940.

From 2. international conference on phase transformations in solids; Cambridge, UK (6 Jul 1987).

The morphology of the phases produced in the iron-chromium system as a result of decomposition within a miscibility gap has been characterized using atom probe field-ion microscopy. The morphology of the chromium-enriched α' phase was found to change smoothly with increasing chromium content from isolated, roughly spherical islands to a highly interconnected isotropic network. These results are consistent with simulations of phase separation in an isotropic system.

39186 **(CONF-870719—2) Characterization of low temperature phase transformations in the iron-beryllium system.** Miller, M.K.; Burke, M.G. (Oak Ridge National Lab., TN (USA); Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011941.

From 2. international conference on phase transformations in solids; Cambridge, UK (6 Jul 1987).

The phase transformations that occur in the iron-rich portion of the iron-beryllium alloy system have been studied by atom probe field-ion microscopy and transmission electron microscopy. These techniques have been successfully employed in the identification of phases developed in Fe-17 at. % Be and Fe-25 at. % Be alloys during aging in the temperature range 265 to 650°C. In addition to the metastable B32 FeBe phase, a new, previously unreported metastable hexagonal equiatomic phase has been observed in the $\alpha + FeBe_2$ phase field.

39187 **(CONF-870733—5) AEM determination of composition profiles formed during cellular precipitation in Ni-In alloys.** Alexander, K.B.; Laughlin, D.E. (Oak Ridge National Lab., TN (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Metallurgical Engineering and Materials Science). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012521.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Cellular precipitation occurs in a wide range of alloys and is generally associated with a degradation in mechanical and electrical properties. In order to suppress the reaction, the factors which govern the kinetics of the reaction must be understood. There have been many theories proposed to account for the growth kinetics of cellular precipitation. To compare the observed growth kinetics with any theoretical model, however, several parameters must be measured: the growth velocity, the interlamellar spacings involved and the amount of non-equilibrium segregation retained in the α lamellae. This last parameter has often been measured by x-ray diffraction methods. However, microanalytical techniques in the transmission electron microscope have proven to be much more informative.

39188 **(CONF-870733—6) Time dependent composition behavior of precipitates in aged stainless steels.** Vitek, J.M.; David, S.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012542.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Precipitation during aging of stainless steels is common and many studies have centered on the identification of these precipitates and the evaluation of the degree of precipitation as a function of aging time and temperature. With the availability of analytical electron microscopes (AEM), the analysis of phase stability can be furthered by the determination of the composition of individual precipitates. Such an analysis was performed on the $M_{23}C_6$ carbides that are found in aged type 308 stainless steel. The compositions were found to vary as a function of aging conditions. In addition, the compositions in selected cases were evaluated by several different procedures in order to evaluate some of the factors that affect the accuracy of such measurements.

39189 **(CONF-8705103—2) In-situ scanning electron microscopy studies of the erosion of alloys.** Keiser, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011938.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Impacts by erosive particles result in the high strain rate deposition of an appreciable amount of energy into the deformed volume of the target material. This energy can be manifested as local heating; softening or even melting has been observed in many materials. Hardening caused by the high strain rate deformation has also been reported for strain hardenable materials. The effect of individual impacts on the surface of selected materials was determined for 343-μm-dia tungsten carbide balls impacting at about 30 m/s and 30° incidence angle. A mechanical properties microprobe was used to measure the hardness of the crater bottom, and just below the original surface. Strain hardening but no evidence of softening was observed in these materials. 26 refs.

39190 **(DOE/ID/12138—6) Corrosion-resistant amorphous metallic coatings: Engineering development: Progress report, October 1, 1985-October 1, 1986.** Fitzgerald, D.J.; DiStefano, S.; Rameshan, R. (Jet Propulsion Lab., Pasadena, CA (USA)). 01 Dec 1986. Contract AI07-80ID12138. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012744.

Objective is to use sputter-deposited amorphous metallic coatings on alloys in heat recovery systems in power plants. It was found that chromium could be used as a substitute for ruthenium in MoRuB. The new alloy, MoCrB, has corrosion current two orders of magnitude lower than MoRuB. The effort to develop the parameters for depositing FeCrPC on steel was frustrated by a persistent pinhole problem. Two titanium-based alloys were developed which are equal to or better than the optimized FeCrPC alloy in terms of corrosion resistance. The potentiodynamic polarization characteristics of MoCrB and TiCrBC were measured over a range in temperature from 25 to 100°C. The corrosion current increased with temperature as predicted by theory. The corrosion characteristics of MoCrB and TiCrPC were also tested in 1.0N HC1. Cost analysis of the magnetron sputtering coating process indicates that the process cost is in the range of $2.50 to $3.00 per square foot steel.

39191 **(EIR—612) Study of the mechanisms for the irradiation embrittlement of reactor pressure vessel steels.** Solt, G.; Zimmermann, U.; Waeber, W.B.; Mercier, O.; Frisius, F.; Ghazi-Wakili, K. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702443.

Irradiation damage particles were detected by small angle neutron scattering and positron annihilation techniques in two RPV steels. The particle radii were 8A and 14A prior to heat treatments for the plate and weldment, respectively; annealing leads to coarsening in the weldment, the volume fraction remains essentially con-

stant at about 0.14%. The model of copper-rich precipitates diluted by Mn atoms or, alternatively, by vacancy agglomerates is consistent with the neutron scattering data, the presence of simple voids in the weldment would contradict the positron results. Preliminary results on these steels and also on related alloys by methods new in this field are reported.

39192 **(EIR—614) Positron annihilation studies on neutron irradiated pressure vessel steels.** Ghazi-Wakili, K.; Zimmermann, U.; Brunner, J.; Tipping, P.; Waeber, W.B.; Heinrich, F. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702444.

It has been demonstrated on a binary model alloy Fe-0.8%Cu heat treated to different states of Cu-distributions in the iron matrix that positron annihilation applied to such simpler systems can give hints for a detailed understanding of neutron irradiation induced defect structures in complex industrial reactor pressure vessel steels (RPV). This study was concerned primarily with a high Cu-content weldment (0.3%) irradiated in a commercial nuclear power plant to a modest fluence of $5.4x10^{17}$ n/cm^2 (E>1 MeV) and a medium Cu-content RPV forging (0.17%) irradiated in a materials test reactor up to $1.9x10^{19}$ n/cm^2. Various positron lifetime and angular correlation-peak height measurements, the latter as a function of annealing temperature up to 750 degrees C, have revealed recovery stages which correlated quantitatively with the microhardness behaviour in the cases of the binary alloy and the forging. The interpretations of the peak height results have led to a detailed picture of precipitation, Ostwald-ripening and dissolution of Cu-rich clusters in the steels. Lifetime measurements in these systems can be understood in terms of trapping effects at the misfit structure of the interfaces between the Cu-precipitates and the iron matrix. They also showed that under the irradiation conditions applied here voids are not produced in the weldment and probably also not in the forging. This finding has been decisive also in the choice of possible model descriptions when interpreting small angle neutron scattering results.

39193 **(EPRI-CS—5277) Guide to 12-Cr steels for high- and intermediate-pressure turbine rotors for the Advanced Coal-Fired Steam Plant: Final report.** Newhouse, D.L. (Engineering Materials and Processes, Inc., Pittsburgh, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 153p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920517.

Recent modifications in composition and processing have produced high-chromium rotor steels of greatly increased creep rupture and fatigue strength. In this guide, utilities will find the data they need to evaluate and compare these modified 12-Cr rotor alloys for use in upgraded and new fossil fuel cycling plants.

39194 **(FhG-W—11/85) Determining the J crack resistance curves on plates with surface cracks.** Hodulak, L.; Stoeckl, H. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Sep 1985. 40p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06304.

J crack resistance curves were determined experimentally on plates with surface cracks and on smooth and notched compact samples of the same thickness made of 22 Ni Mo Cr 37 in the context of investigations of the analysis and further development of fracture mechanics concepts based on the J integral and to verify the transmission chain of flat, small laboratory sample,-> component. Using a 3D elastic-plastic finite element calculation for a plate without crack growth with simplified boundary conditions, the experimental methods for J determination were tested. In the test case, the values of the J integral calculated by the finite element method are higher at most load stages than those obtained by the Garwood method, and lower than those obtained by the Read method. The investigations show that the J-R curves measured on notched compact samples can be used for the conservative assessment of surface cracks in plates of equal thickness.

39195 **(GKSS—86/E/52) R-curve behaviour of double edge notched tension specimens in plane stress.** Hellmann, D.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 8p. NTIS, PC E07; Available from NTIS as TIB/B87-06480.

Crack growth resistance curves in terms of the J-integral and δ/sub 5/ were measured on two double edge notched tensile (DENT) specimens made of Al2024-FC, utilizing the DC potential drop method. The results were in good agreement with those obtained in previous work on other specimen geometries.

39196 **(GKSS—86/E/56) Correlation of stable crack growth with J-integral and crack tip opening for plane stress.** Hellmann, D.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 18p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06481.

The experimental investigation was aimed at establishing empirical criteria for the limits up to which the J-integral and the crack tip opening displacement, δ/sub 5/, measured over a gage length of 5 mm can serve as correlation parameters for stable crack growth. The relevant quantities which may affect crack growth were systematically varied: material (Al alloys, 35 NiCrMo16 = 1.2766), specimen geometry, pre-crack length, and specimen width. Under plane stress conditions, both J and δ/sub 5/ correlate crack growth much better on CCT specimens than on CT or SENB specimens. Furthermore, on CT and SENB specimens δ/sub 5/ correlates about 5 times as much crack growth as J. In plane stress, the CCT geometry has a much bigger measurement capacity than in plane strain, the actual value for the J/sub R/-curve depending on the strain hardening properties of the material.

39197 **(GKSS—87/E/4) Irradiation behavior of reactor pressure vessel steels from the research program on the integrity of components.** Ahlf, J.; Bellmann, D.; Hebenbrock, H.D.; Schmitt, F.J.; Spalthoff, W.; Foehl, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). 1987. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-08681.

Within the research program 'Integrity of Components', reactor pressure vessel steels are irradiated in capsules in the swimming-pool-type research reactor FRG-2 at 290/sup 0/C to different fluences of fast neutrons. Steel heats both conforming and not conforming to specifications with respect to chemical compositions as well as to tensile and deformation properties are included. So far, the results show that for the materials investigated the 41 J transition temperature shift from impact testing is always larger than the nil ductility transition (NDT) shift from drop-weight testing. This means that the mode of procedure of the regulatory rules leads to conservative values for the adjusted reference temperature even for material states near and beyond the specification limits. From instrumentated Charpy tests, the arrest load was determined. It was found that the irradiation-induced shift of the arrest load versus temperature curve corresponds closely to the NDT shift. By evaluating Charpy surveillance specimens along this line, one has a supplementary criterion for assessing irradiation embrittlement at hand. At low fluences, the 41 J transition temperature shifts are conservatively predicted by the trend curves of Regulatory Guide 1.99, whereas at high fluences - though a little beyond the validity limits - these shifts lie above the extrapolated trend curves.

39198 **(Juel—2081) Hydrogen and deuterium in vanadium as lattice gases with repulsive short-range interactions.** Meuffels, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.)). Aug 1986. 145p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06460.

Pressure-composition isotherms at temperatures between 150 and 550/sup 0/C for solutions of hydrogen and deuterium in vanadium and the temperature dependence of the heat capacity in a series of V-D alloys have been determined in the single phase regions (α-phase) of the V-H(D) phase diagrams. The concentration

dependences of the partial molar enthalpies Δanti H/sub H(D)/ and entropies Δanti S/sub H(D)/ of hydrogen and deuterium have been derived from the solubility data. For both isotopes Δanti H/sub H(D)/ decreases with increasing H or D concentration x = [H(D)]/[V] at low x and increases a higher H or D content, having a minimum near x≅0.4. The concentration dependence of Δanti S/sub H(D)/ shows a large negative deviation from the ideal configurational entropy for random occupation of tetrahedral interstitial sites. The heat capacity of V-D/sub x/ contains a substantial excess contribution, which remains when estimated electronic and vibrational contribution are subtracted from the experimental data. The experimental results are analyzed by means of Monte Carlo simulations of a lattice gas with repulsive short range interactions between hydrogen (deuterium) atoms. The essential features of the experimental results are described by a lattice gas model which includes hard core interactions (blocking effect) and finite repulsive interactions outside the hard core.

39199 **(Juel—2088) Special neutron measurement results from the spectral positions of the Juelich FKS steel irradiation capsules.** Schneider, W.; Kuepper, H.; Pott, G.; Borchardt, G.; Segelhorst, G.; Thoene, L.; Weise, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Brennelement- und Bestrahlungstechnologie; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Forschungsreaktoren). Oct 1986. 48p. NTIS, PC E07; Available from NTIS as TIB/B87-10207.

For the German project 'Forschungsvorhaben Komponentensicherheit' (FKS, i.e., Structural Integrity of Components) steel specimen irradiations have been carried out in the Juelich Merlin-type reactor (FRJ-1). The neutron monitoring to these irradiations is described in a German report (Juel-2087). In this context, some special considerations and results are given here, i.e., an experimental investigation of the fast neutron spectrum variation over a thick steel plate (in a special dosimetry test experiment); a comparison of the outcome of this investigation with the results from other FKS participants; and finally, the evaluation of the neutron exposure expressed in displacements per atom (dpa) in the centre of that steel plate.

39200 **(Juel—2092) Creep rupture behaviour of weldings of a Ni-based alloy with special regard to the local deformation behaviour.** Kaffka, M.; Ennis, P.J.; Schuster, H.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.)). Oct 1986. 184p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-06276.

Dissertation submitted by Michael Kaffka.

Plate, sheet and tube product forms of the high temperature alloy NiCr 22 Co 12 Mo have been welded using matching filler. When specimens made from such weldments are creep tested normal to the weld seam, the different zones of the specimens (parent metal, heat-affected zone and weld metal) undergo different amounts of creep strain. In this investigation, it is shown that information concerning the creep behaviour of the individual weldment zones is not sufficient for the determination of the integral strain of the weldment. Constraint of the creep strain at the weld-parent metal transition can significantly influence the creep behaviour of the weldment. This effect has been experimentally demonstrated for cylindrical, tubular and flat welded specimens. For a simple transition structure, finite element calculations have been performed and the observed behaviour theoretically reproduced. The decisive parameter for the integral creep strain of a weldment is the volume fraction of weld metal in the gauge length of the specimen. Specimens of different geometrical form but with similar volume fractions of weld metal in the gauge length exhibited similar creep behaviour in tests of up to 2000 h duration. From the relationship between weld metal volume fraction and integral creep strain, a method has been developed which allows the determination of the strain distribution in a weldment; the method requires only the usual type of creep test with weldments to be performed.

39201 **(LBL—23474) Mass transport and potential distribution in the geometries of localized corrosion.** Newman, J. (Lawrence Berkeley Lab., CA (USA)). 24 Jun 1987. Contract AC03-76SF00098. 42p. (CONF-870658—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012819.

From International conference on localized corrosion; Orlando, FL, USA (1 Jun 1987).

Localized corrosion, such as pitting, crevice, and water-line corrosion, necessarily involves a passivating metal - one for which an increase in the local electrode potential results in a decrease in the dissolution current. In this situation, the anodic and the cathodic reactions occur in different locations. Consequently, transport of charge and material species in the solution is involved in processes of localized corrosion. Here fundamental aspects of mass transfer and potential distribution are reviewed with an eye toward applications in localized corrosion. Recent work on passivation, salt-film formation, and oscillatory behavior on iron in 1 M sulfuric acid is reviewed as well as modeling efforts on the partly active, partly passive corrosion of rotating iron disks in sea water.

39202 **(LBL—23665) Acid-base reactions of transition metal alloys: Thermochemistry of the base-rich end.** Bularzik, J.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012817.

The thermodynamics of binary transition metal alloys, stabilized by generalized Lewis acid-base reactions, were studied within the context of the Engel-Brewer Theory. The activity of the base metals was determined from the vapor pressure measurements of the Pd or Rh in the base-rich end of TiPd, VPd, NbPd and VRh alloys. The vapor pressures were determined by thermally induced atomic emission spectroscopy. The composition of the alloys in equilibrium with carbon were determined. From the known thermodynamics of the metal carbides, the activity was calculated for the acid metals. Titration curves from the pure base metal to the compositions in equilibrium with carbon were developed. The data confirmed the general qualitative properties of the acid-base reaction. The 4d metals are better acids than the 3d metals. The effectiveness of the acid-base reaction across a transition series is determined by the number of d electron pairs available for donation, the number of empty d orbitals available to accept electron pairs, the nuclear charge and a crystal field effect. The data was compared to the regular solution model in an attempt to represent the solution behavior.

39203 **(SAND—86-2796C) Gaseous contaminants modify the friction and wear response of precious metal electrical contact alloys.** Pope L.E.; Peebles, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 28p. (CONF-870960—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007862.

From 33. IEEE/Holm conference; Chicago, IL, USA (21 Sep 1987).

An in-situ electrical contact resistance and friction coefficient measuring device has been installed in a scanning Auger microprobe. A pin-on-plate experimental configuration is used. This tribology system has been used to characterize the friction, wear and electrical contact resistance of a Pd alloy pin (ASTM B540) sliding on a Au alloy plate (ASTM B541). Studies have been completed with and without H_2S in the atmosphere for wear in 1.6 x 10^{-6} torr O_2, 700 torr of 5% O_2 in N_2 and 700 torr He. The presence of H_2S reduces the friction coefficient and decreases the wear track width on the Au alloy. The lower friction is associated with adsorption and reaction of the H_2S with the Au alloy plate. In the ambients containing H_2S, large accumulations of S in wear tracks are observed; however, no increase in the electrical contact resistance occurs. In the 700 torr ambients containing H_2S, Cu segregates to the wear track surfaces to the exclusion of the other metallic elements and forms Cu_2S layers. A concomitant shift occurs in the S and Cu Auger peak positions when the Cu_2S film thickens.

39204 **(SAND—87-0591C) Measurement of transformation kinetics in Ni-B metastable crystalline and amorphous alloys by DSC.** Roth, E.P.; Campbell, A.N.; Mullendore, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870988—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010953.

From 16. annual conference of the North American Thermal Analysis Society; Washington, DC, USA (27 Sep 1987).

Chemical vapor deposition (CVD) has been used to prepare amorphous and polycrystalline films of Ni-B from nickel carbonyl and diborane at 155°C. Three low-boron content samples containing 2.6, 5.3, and 13.0 at. % boron were prepared which had a fine-grained polycrystalline structure of fcc nickel supersaturated with boron. A high-boron content sample was prepared containing 37 at. % boron and was completely amorphous. Upon heating above 300°C, Ni_3B precipitates from the polycrystalline low-boron content samples, while Ni_2B and Ni_4B_3 forms from the high-boron content sample near 500°C. While the mechanical properties of some of these alloys are enhanced during the initial stages of transformation, the coarsening of the microstructure during extensive annealing is accompanied by a decrease in strength and hardness. A DSC study of the Ni-B alloys was undertaken to assess the thermal stability of the as-deposited microstructure. The enthalpies and kinetics of intermetallic formation were studied with both constant-heating-rate (CHR) and isothermal measurement techniques.

39205 **(SAND—87-0868C) A method for electroforming small nickel cans for the MC3748 insertable initiator.** Martinez, F.E.; Voytko, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-8704143—1). NTIS, PC A02. File Number DE87010436.

From Integrated contractors meeting on coatings and SUBWOG 12A; Kansas City, MO, USA (27 Apr 1987).

A method for fabricating deep, thin-walled, small nickel cans has been developed for production using an electroforming process. Multiple parts are formed on permanent mandrels by electroplating from a low stress nickel sulfamate solution. Nine parts electroformed at a time exhibit uniform wall thickness (0.002 plus or minus 0.0002 inches) throughout the part and among the parts on the fixture. The electroforms are removed from their mandrel by an operation of lightly grit-blasting the part and separating it from the reusable mandrel.

39206 **(SAND—87-0955C) Modeling of shock-induced chemistry in nickel-aluminum systems.** Taylor, P.A.; Boslough, M.B.; Horie, Y. (Sandia National Labs., Albuquerque, NM (USA); North Carolina State Univ., Raleigh (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870753—30). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012404.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

We report on real-time shock-induced temperature measurements of a Ni-Al powder mixture that indicate exothermic chemical reactivity and a model to describe this reactivity at a hot spot site where rapid thermal diffusion is occurring.

39207 **(SAND—87-1041C) The effects of microstructure on the hardness and deformation mode of shock-loaded 6061 aluminum and JBK-75 stainless steel.** Carr, M.J.; Hills, C.R.; Graham, R.A.; Wise, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—19). NTIS, PC A02. File Number DE87012364.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Two age-hardening alloys, 6061 aluminum and JBK-75 stainless steel (modified A-286) were each heat treated to three distinct microstructural conditions: solutionized, peak aged, and overaged, and then subjected to shock recovery experiments at 6 GPa and 35 GPa, respectively. Characterization consisted of hardness measurements and optical transmission electron microscopy both in the unshocked condition and in the post-shock-loaded condition. Hardness measurements were also made on samples slowly compressed to a plastic strain equivalent to the maximum strain experienced under shock. The post-shock hardness and microstructure was found to be influenced by the initial microstructural state.

39208 **(SAND—87-1703C) Nucleation and growth of Cr on stepped surfaces with facets: An FEEM [field emission microscopy] study.** Melmed, A.J.; Shinn, N.D. (Sandia National Labs., Albuquerque, NM (USA); National Bureau of Standards, Washington, DC (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870780—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012401.

From 34. international field emission symposium; Osaka, Japan (13 Jul 1987).

The nucleation and epitaxial growth of Cr crystals resulting from vapor-deposition of Cr onto thermally annealed W and Re surfaces has been studied using field electron emission microscopy. The substrate surfaces consisted of low-index facets and terraces separated by atomic steps. Multiple nucleation, leading to polycrystal growth, could not be avoided on the Re surfaces. The Cr/W system was studied more extensively and was found to yield some surprising results. In the temperature range of about 500 to 1050°K, nucleation and growth of Cr crystals occurred only after 1 to 2 monolayers of Cr atoms had formed (the Stranski-Krastinov mode). However, around 300°K on {011 W planes, two different growth modes were observed consistently depending upon the vapor-deposition grometry: the Stranski-Krastanov or the Volmer-Weber mode.

39209 **(UCRL—95609) Suppression of the uranium-hydrogen reaction using high-dose carbon implantation.** Musket, R.G. (Lawrence Livermore National Lab., CA (USA)). 17 Apr 1987. Contract W-7405-ENG-48. 9p. (CONF-870438—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010876.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

We have previously reported the delay and reduction of the hydriding of uranium by implantation of oxygen. The reduced hydriding was attributed to the presence of the uranium oxide layer created near room temperature. In this paper we present results for the layers formed by implantation of 80 keV C^+ to a dose of 8E17 C/cm^2. The carbide layers formed were characterized by Auger electron spectroscopy, Rutherford backscattering, and glancing angle x-ray diffraction. Hydriding properties of both non-implanted and implanted uranium were measured for 76 Torr hydrogen at 130°C. The implanted specimens had significantly longer incubation times for the start of the reaction after exposure to hydrogen and less area participating in the reaction.

39210 **(UCRL—96431) Release isentrope measurements with the LLNL electric gun.** Gathers, G.R.; Osher, J.E.; Chau, H.H.; Weingart, R.C.; Lee, C.G.; Diaz, E. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011548.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The liquid-vapor coexistence boundary is not well known for most metals because the extreme conditions near the critical point create severe experimental difficulties. The isentropes passing through the liquid-vapor region typically begin from rather large pressures on the Hugoniot. We are attempting to use the high velocities achievable with the Lawrence Livermore National Laboratory (LLNL) electric gun to obtain these extreme states in aluminum and measure the release isentropes by releasing into a series of calibrated standards with known Hugoniots. To achieve large pressure drops needed to explore the liquid-vapor region, we use argon gas for which Hugoniots have been calculated using the ACTEX code, as one of the release materials.

39211 **(UNI—3601) Postirradiation examination of pressure tubes 2755 and 1054: Part 1, Dimensional hydride, inner surface defects, and corrosion measurements.** Lawrence, L.A.; Trimble, D.J. (UNC Nuclear Industries, Inc., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01857. 164p. NTIS MF A01; 2; GPO Dep. File Number DE87007104.

Detailed examinations were conducted on Pressure Tubes 2755 and 1054 removed from N Reactor April 1984 and October

1984, respectively, to evaluate the effects of the operation environment on tube properties. Examinations provided data necessary for the definition of the pressure tube operating envelope and service lifetimes. Examinations reported in Part 1 of this report include dimensional measurements, hydriding, surface oxidation, characterization of inner-surface defects, neutron fluence, and microstructural stability. Mechanical behavior (i.e., fracture toughness) and tensile will be included as Part 2 of this report.

39212 **(YJT—86-34) Corrosion of iron and low alloy steels in the repository environment.** Aaltonen, P.; Haenninen, H.; Carpen, L. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Dec 1986. 76p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751936.

Prior to disposal in bedrock spent fuel is planned to be enclosed in metallic canisters. Canister materials can be either thermodynamically stable in the repository environment as copper, passive as titanium or they can corrode as iron-base materials. Metals such as iron and unalloyed steels can be used as canister materials if the material thickness is large enough to allow corrosion This report summarizes the published results relevant to the corrosion of iron base materials in repository conditions. The general corrosion behaviour of iron-base materials is discussed.

39213 **(YJT—87-02) Electrochemical study on the corrosion of the metal waste embedded in concrete.** Hietanen, S.; Klemetti, K.; Aaltonen, P. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Jan 1987. 37p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751937.

The corrosion rates of metal waste embedded in concrete in repository conditions is evaluated. The materials studied are a carbon steel, a stainless steel and a zirconium alloy. The metal specimens were embedded in three types of concrete. Test specimens were immersed in various types of ground water. Electrochemical polarization resistance experiments were used to study the rate of corrosion of metal specimens in concrete. Pores and cracks in the concrete are found to have a clear effect on the determined corrosion rates. On the other hand the observed corrosion rates are not affected by the studied concrete types or the studied ground water chemistry. The measured corrosion rates are small. The highest value observed is about 2.5 mm/1000 a.

39214 **Dual phase formation in multilayered Ni-Al by ion beam mixing.** Eridon, J.; Was, G.; Rehn, L. (Department of Nuclear Engineering, University of Michigan, Ann Arbor, Michigan 48109). *Journal of Applied Physics;* **62**: No. 5, 2145-2147(1 Sep 1987).

Ion beam mixing is used to homogenize multilayered thin films of nickel and aluminum, vapor deposited onto pure nickel substrates. Doses of 500-keV Kr^+ at fluences of 2 x 10^{16} ions/cm^2 produced a supersaturated solid solution of between 16 and 23 at. % aluminum in nickel at room temperature. Subsequent thermal treatment at 425 °C for 1 h resulted in the formation of a dual phase structure of γ and γ' with grain sizes in the range 640 to 710 A. Although the dual phase structure was obtained either by ion beam mixing followed by thermal annealing or by thermal annealing alone, only the former process resulted in a surface film with a texture. The films are stable against thermally induced grain growth at temperatures up to 700 °C for 10 h.

39215 **Proximity effect depression of the critical temperature in two-phase Nb-Ti superconductors.** Meingast, C.; Daeumling, M.; Lee, P.J.; Larbalestier, D.C. (Applied Superconductivity Center, University of Wisconsin, Madison, Wisconsin 53706). *Applied Physics Letters;* **51**: No. 9, 688-689(31 Aug 1987).

The superconducting critical temperature of high critical current density Nb-Ti composites has been measured at various stages in the critical current optimization process. This process involves heat treatment steps which cause precipitation of normal α-Ti and make the matrix more Nb rich. T/sub c/ rises from 9.1 to 9.5 K during this stage. The final optimization stage involves extensive wire drawing during which the α-Ti precipitates are reduced to less than a coherence length in thickness. This does not result in a reduction in J/sub c/ but T/sub c/ is found to fall from 9.44 to 8.7 K during this step. The depression of T/sub c/ is found to be in fair agreement with the predicted proximity effect suppression of T/sub c/. Wires of optimum transport critical current density are seen to have T/sub c/ of around 9 K.

39216 **Point-contact spectra of the heavy-fermion superconductors UBe/sub 13/ and UPt_3.** Nowack, A.; Heinz, A.; Oster, F.; Wohlleben, D.; Guentherodt, G.; Fisk, Z.; Menovsky, A. (II. Physikalisches Institut, Universitaet Koeln, 5000 Koeln 41, Federal Republic of Germany). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2436-2439(1 Aug 1987).

We have measured the current-voltage characteristics of point contacts between UBe/sub 13/ or UPt_3 and the normal metals W or Pt (metallic point contacts) or GaAs (Schottky-barrier tunneling contact) in the temperature range between 50 mK and 1 K. In the metal-point-contact characteristics (dV/dI vs V) there appear zero-bias minima of width 2Δ below T/sub c/. The ratio 2Δ/k/sub B/T/sub c/ is close to the BCS value. The tunneling spectra of UPt_3 exhibit weak additional structure below T/sub c/. A value 2Δ has been estimated, which is a factor of 2 larger than that for the metal point contacts.

39217 **Electronic fluctuation and cohesion in metals.** Maggs, A.C.; Ashcroft, N.W. (Laboratory of Atomic and Solid State Physics and Materials Science Center, Cornell University, Ithaca, New York 14853-2501). *Physical Review Letters;* **59**: No. 1, 113-116(6 Jul 1987).

This Letter is concerned with effective interatomic potentials in metals specifically arising from electronic quantum fluctuations. The cohesive energy is shown to contain large terms arising from generalized dispersion forces. Further, the density-density response function of the homogeneous electron gas is shown to contain a part decaying monotonically as $1/r^6$ in real space; this has consequences in the construction of generalized functional theories of interatomic potentials.

39218 **Effect of boron on the mechanism of strain transfer across grain boundaries in Ni_3Al.** Bond, G.M.; Robertson, I.M.; Birnbaum, H.K. (Department of Materials Science and Engineering and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Materials Research;* **2**: No. 4, 436-440(Jul 1987). Contract AC02-76ER01198.

The effect of boron on the mechanism of strain transfer across grain boundaries in Ni_3Al has been investigated by dynamic recording of events occurring during in-situ straining in the transmission electron microscope. Boundaries in both doped and undoped material can act as effective barriers to dislocation motion, large numbers of dislocations being incorporated into the boundary without any plastic strain occurring in the adjacent grain. In the undoped material, the grain-boundary strain is relieved by the sudden failure of the grain boundary. In the doped material the strain is relieved by the sudden generation and emission of large numbers of dislocations from the grain boundary. This effect may be understood by boron either increasing the grain-boundary cohesion or reducing the stress required to operate grain-boundary dislocation sources, rather than easing the passage of slip dislocations through the grain boundary.

39219 **Surface alloying by ion, electron, and laser beams; Proceedings of the Materials Science Seminar, Toronto, Canada, Oct. 12, 13, 1985.** Rehn, L.E.; Wiedersich, H.; Picraux, S.T. Metals Park, OH; American Society for Metals (1987). 429p. (CONF-8510160—).

From ASM metals congress/TMS-AIME fall meeting; Toronto, Ontario, Canada (13 Oct 1985).

Papers are presented on energy deposition, heat flow, and rapid solidification during pulsed-laser and electron-beam irradiation of materials; the kinetics of resolidification; atomic displacement processes in ion-irradiated materials; and solute redistribution under nonequilibrium conditions. Consideration is given to microstructures of surface-melted alloys; solute trapping in ion-implanted metals; the superconducting effects of surface alloying by ion, elec-

tron, and laser beams; and the mechanical effects of ion beams on surface alloys. Topics discussed include the chemical effects of ion implantation, in particular oxidation, corrosion, and catalysis; laser and electron beams; industrial applications of ion beam processes; and the surface alloying of large and complex shapes.

39220 **A study of the heat transfer during arc welding with applications to pure metals or alloys and low or high boiling temperature materials.** Choi, M.; Greif, R.; Salcudean, M. (Dept. of Mechanical Engineering, Univ. of California, Berkeley, CA 94720). *Numerical Heat Transfer;* **11**: No. 4, 477-491(1987).

An analysis of the heat transfer during arc welding has been carried out. The study is applicable to pure metals or alloys and to low or high boiling temperature materials and includes the effects of conduction, radiation, evaporation, boiling, and variable properties. Two evaporation models were studied and the results were compared with experiment data for stainless steel. The penetration depth was also calculated for lead, a low boiling temperature material, and the results were compared with previous calculations and with experimental data.

39221 **Using fuel cells or anode depolarization to reduce electrowinning energy consumption.** Cook, G.M. (Argonne National Lab., Argonne, IL 60439). pp 285-296 of Energy reduction techniques in metal electrochemical processes. Bautista, R.G.; Wesely, R.J. Warrendale, PA; The Metallurgical Society Inc. (1985).

Some existing and proposed metal electrowinning plant sites have hydrogen available to reduce the need for purchased energy. Hydrogen can reduce the energy consumption of electrowinning processes by depolarizing the anode; alternatively, it can be used in a fuel cell to generate D.C. electricity and heat at high efficiency. The use of H/sub 2/ to depolarize an anode in zinc electrowinning has been shown to reduce overall cell voltage by nearly 2 volts at 450 A/m/sup 2/. In a fuel cell, electricity can be produced with an efficiency of about 45 to 50% compared to about 30 to 32% for conventional generating equipment and the heat produced is available at temperatures which vary from about 150°C for phosphoric acid fuel cells to 550 to 800°C for advanced high temperature fuel cell systems.

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REFER ALSO TO CITATION(S) 38648, 38687, 38797, 38841, 39160, 39198, 39261, 39437, 39439

39222 **(CONF-870388—13) RBS and AES characterization of HRRS (Hf,Ti)N coatings.** Fenske, G.R.; Kaufherr, N.; Sproul, W.D. (Argonne National Lab., IL (USA); Borg-Warner Corp., Des Plaines, IL (USA)). 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01. File Number DE87011521.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

Coatings of (Hf,Ti)N deposited by HRRS (High-Rate Reactive Sputtering) were analyzed to determine the effect of film composition on microhardness. Solid-solution hardening was observed and was dependent on the partial pressure of the reactive gas. At the pressure where hardening was observed the maximum hardness occurred at a Ti:(Ti+Hf) ratio of ~50%.

39223 **(CONF-870733—8) An analytical electron microscopy investigation of amorphous structures in ion-implanted Al_2O_3.** Sklad, P.S.; Angelini, P.; McHargue, C.J.; White, C.W. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012537.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Recently characterization of the microstructure of as-implanted ceramics in order to understand the basic physical effects involved in this processing technique has been the subject of extensive investigation. Of equal importance is the behavior of the modified material during post-implantation treatments. Analytical electron microscopy (AEM) is ideally suited to this type of investigation. This paper describes the results of an AEM study of the difference between two types of amorphous Al_2O_3; the first made amorphous by implanting crystalline α-Al_2O_3 with a stoichiometric ratio of aluminum and oxygen at -185°C, and the second by implanting with iron at -185°C. The different response of these two materials to post-implantation annealing suggests a fundamental chemical or structural difference in the as-implanted state. Analysis of the extended energy loss fine structure as well as the diffuse halos in selected area electron diffraction patterns indicate that structural differences do exist.

39224 **(CONF-8706125—8) The influence of ion-irradiated induced disorder and post-annealing on thin film superconductive compounds MoN, VN, and TiN.** Christen, D.K.; Ellis, J.T.; Sekula, S.T.; Thompson, J.R.; Lewis, J.D.; Anderson, W.R.; Pennycook, S.J. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics; Carleton Coll., Northfield, MN (USA)). Jun 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02. File Number DE87012525.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

Thin films of the three superconducting ordered compounds MoN, VN, and TiN have been synthesized by high temperature gas reaction of the pure metal films in a nitrogen-rich atmosphere. X-ray diffraction showed that the as-formed films were single phase, with VN and TiN having the B1 structure and MoN having a modified simple hexagonal structure. Lattice disorder was introduced systematically by irradiation with nitrogen ions of energies 45 and 340 keV, resulting in nearly uniform damage profiles over the film thickness. Both the residual resistivity rho$_0$ and the superconducting transition temperature T/sub c/ are exponentially saturating functions of the ion fluence, with decay constants and saturation values that correlate with the relative stabilities of the three materials. Isochronal annealing of the samples in a nitrogen-rich environment results in recovery of the properties. Annealing in vacuum leads to first recovery and then progressive decomposition of the compounds.

39225 **(DPST—86-743) Natural ceramic container material for groundwater control.** Jantzen, C.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 29 Dec 1986. Contract AC09-76SR00001. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012634.

The ceramic is to be used to fabricate containers for the burial of low level waste. SRL evaluated the durability of this material and the following conclusions can be made: based on the silicon release to solution, the material is chemically very durable, due to its high silica and alumina content; and porosity, ductility, and fabrication technology of the ceramic would need to be evaluated before it could be recommended for service.

39226 **(EUR—9938) Theoretical investigations of extrinsic defects in diamond-type solar material.** Sirtl, E.; Spindler, O. (Commission of the European Communities, Luxembourg). 1985. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752654.

In the first part of this report special lattice situations are described for interstitial sites in different polytypes, primarily in silicon carbide. Whereas a part of such interstitial positions are identical with those that have been characterized in precedent reports, other configurations must be seen as a combination of both cubic and hexagonal atomic arrangements. The second part deals first with efforts to determine effective radii of single foreign atoms (impurities) in the silicon lattice via their effective charges. This was partially done by appropiate equations, partially by graphical fitting. When plotting the resulting data versus the different segregation coefficients k/sup 0/ it was hoped to obtain rather clear funtional behaviour. It turned out, however, that the presently available experimental data need revision and completion as well before a more detailed judgement of the different theoretical models is possible.

39227 **(FRNC-TH—2350) Piezoelectric materials with ferroelectric-antiferroelectric low pressure transition used for mecanoelectric energy conversion.** Grange, G. (Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 200p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752197.

Ferroelectric materials synthesis, electrical and thermodynamical characterization and applications are studied. Ferroelectric ceramics with a perovskite structure ABO/sub 3/ are used in conversion by ferroelectric-antiferroelectric phase change. Composition of ternary solid solutions is determined and applied to Pb (Hf/sub 1-y/Zr/sub y/)/sub 1x/ Ti/sub x/O/sub 3/ and Pb (Sn/sub 1y/Zr/sub y/) Ti/sub x/O/sub 3/ doped with 1% of Nb or La. They are prepared by oxide mixture and sintering. 73 refs.

39228 **(INIS-mf—10256) Microstructure and mechanical properties of SiC materials.** Yarahmadi, M. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 17 - Werkstoffwissenschaften). 23 Jul 1985. 165p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-10096.

The effect of the microstructure on the mechanical properties of SiC materials of different chemical composition (SSiC, SiSiC, and RSiC) was investigated. Furthermore, the creep strength was determined on oxidized samples and on non-pretreated samples. (HSCH).

39229 **(Juel—2096) Neutron scattering on hydrides of intermetallic compounds.** Hempelmann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Nov 1986. 218p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-08456.

This review surveys the application of neutron scattering for the investigation of the microscopic behaviour of hydrogen in intermetallic compounds. This concerns the structure as well as the dynamics. Neutron diffraction experiments were performed on Ti/sub 1.2/Mn/sub 1.8/D/sub 3/ and LaNi/sub 5/D/sub 7/. In the latter case the dominant nickel scattering could be suppressed by isotope substitution with /sup 60/Ni, and the anisotropic broadening of the Bragg peaks could be modelled in a correspondingly modified Rietveld-profile refinement. For the investigation of hydrogen diffusion in intermetallic hydrides by means of quasielastic neutron scattering an iterative multiple scattering correction procedure has been developped which allows a reliable determination of hydrogen diffusion coefficients. The mechanism of hydrogen diffusion in intermetallic hydrides comprises three types of jumps: escape jumps out of energetically lower interstitials, transport jumps over the energetically higher sites and locally restricted jump processes. For Ti/sub 1.2/Mn/sub 1.8/H/sub 3/ the main features of the diffusional behaviour could be described quantitatively in the framework of a three state model. By means of neutron vibrational spectroscopy information about the occupied hydrogen sites and thus about the structure can be extracted from the symmetry splitting of the vibrational modes. In this way we showed that in α-LaNi/sub 5/H/sub x/, La/sub 2/Ni/sub 4/-octahedral and La/sub 2/Ni/sub 2/-tetrahedral interstitial sites are occupied.

39230 **(N—87-20422) Deformation and fracture of single-crystal and sintered polycrystalline silicon carbide produced by cavitation.** Miyoshi, K.; Hattori, S.; Okada, T.; Buckley, D.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 25p. (NASA-TM—88981; E—3367; NAS—1.15:88981; CONF-871009—1). NTIS, PC A02/MF A01.

From American Society of Lubrication Engineers and the American Society of Mechanical Engineers lube conference; San Antonio, TX, USA (5 Oct 1987).

An investigation was conducted to examine the deformation and fracture behavior of single-crystal and sintered polycrystalline SiC surfaces exposed to cavitation. Cavitation erosion experiments were conducted in distilled water at 25 C by using a magnetostrictive oscillator in close proximity (1 mm) to the surface of SiC. The horn frequency was 20 kHz, and the double amplitude of the vibrating disk was 50 microns. The results of the investigation indicate that the SiC (0001) surface could be deformed in a plastic manner during cavitation. Dislocation etch pits were formed when the surface was chemically etched. The number of defects, including dislocations in the SiC (0001) surface, increased with increasing exposure time to cavitation. The presence of intrinsic defects such as voids in the surficial layers of the sintered polycrystalline SiC determined the zones at which fractured grains and fracture pits (pores) were generated. Single-crystal SiC had superior erosion resistance to that of sintered polycrystalline SiC.

39231 **(N—87-20425) Hot corrosion attack and strength degradation of SiC and Si(sub)$_3$N(sub)$_4$.** Smialek, J.L.; Fox, D.S.; Jacobson, N.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 12p. (NASA-TM—89820; E—3466; NAS—1.15:89820; CONF-870466—4). NTIS, PC A02/MF A01.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Thin films of Na_2SO_4 and Na_2CO_3 molten salt deposits were used to corrode sintered SiC and Si_3N_4 at 1000 C. The resulting attack produced pitting and grain boundary etching resulting in strength decreases ranging from 15 to 50 percent. Corrosion pits were the predominant sources of fracture. The degree of strength decrease was found to be roughly correlated with the depth of the pit, as predicted from fracture toughness considerations. Gas evolution and bubble formation were key aspects of pit formation. Many of the observations of furnace exposures held true in a more realistic burner rig test.

39232 (N—87-20522, pp vp) **Oxidation of carbon monoxide using a tin oxide catalyst.** Sampson, C.F.; Gudde, N.J. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

This paper outlines some of the steps involved in the development by the United Kingdom Atomic Energy Authority (UKAEA) of a catalytic device for the recombination of carbon monoxide and oxygen in a CO_2 laser system. It contrasts the differences between CO oxidation for air purification and for laser environmental control, but indicates that there are similarities between the physical specifications. The principal features of catalytic devices are outlined and some experimental work described. This includes measurements concerning the structure and mechanical properties of the artifact, the preparation of the catalyst coating and its interaction with the gaseous environment. The paper concludes with some speculation about the method by which the reaction actually occurs.

39233 **(SAND—86-2658C) Icosahedral boron-rich solids as refractory semiconductors.** Emin, D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 13p. (CONF-870438—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012103.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Icosahedral boron-rich solids are refractory materials composed of twelve-atom boron-rich icosahedral units with strong intericosahedral linkages. These distinctive structures admit unusual electronic and thermal transport properties. Here the distinctive (three-center) bonding which underlies these materials is first described. Then it is shown how insulators, semiconductors and highly degenerate (metal-like) materials emerge from the same basic structure with appropriate substitutions. The electronic transport of the boron carbides is then addressed. The boron carbides are degenerate p-type semiconductors in which the charge carriers are diamagnetically aligned pairs of electrons which hop between icosahedra. Uniquely, this thermally activated hopping conductivity increases with increasing hydrostatic pressure. However, the Seebeck coefficient (thermoelectric power) is uncharacteristic of a degenerate semiconductor. Namely, the Seebeck coefficient is typically both large and an increasing function of temperature. In addition, despite the hardness and refractory character of these materials, their thermal conductivities can be surprisingly low with a glass-like temperature dependence. These features are manifestations of the distinctive structure and bonding of these solids. In

fact, this novel mix of properties makes the boron carbides exceptionally good very-high-temperature p-type thermoelectric materials. Icosahedral boron-rich solids have additional potential as high temperature semiconductors. In particular, the wide-gap icosahedral boron-rich pnictides, $B_{12}P_2$ and $B_{12}As_2$, may be doped to form wide-gap refractory semiconductors. For example, replacement of the group V element with either a group VI or a group IV element is expected to yield n-type and p-type material, respectively. 41 refs.

39234 Optical, mechanical, and thermal properties of barium borate. Eimerl, D.; Davis, L.; Velsko, S.; Graham, E.K.; Zalkin, A. (Nonlinear Optical Materials Group, Lawrence Livermore National Laboratory, P. O. Box 5508, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 5, 1968-1983(1 Sep 1987).

We report measurements of all the material constants necessary to fully characterize barium borate as a nonlinear optical material. All data was taken on crystals supplied by Professor Chuangtien Chen, Fuzhou, People's Republic of China. We have determined the crystal structure, the optical absorption, the refractive indices from the UV to the near IR, the thermo-optic coefficients, the nonlinear optical or coefficients, the resistance to laser damage, the elastic constants, the thermal expansion, thermal conductivity and dielectric constants, and the fracture toughness. This data is used to evaluate barium borate for a variety of applications. We find that, in general, barium borate has a low acceptance angle, and that despite its higher optical nonlinearity, it is therefore not significantly more efficient than other commonly available materials, except in the UV below 250 nm. On the other hand, it has a high damage threshold, it is physically robust, it has good UV and IR transparency, and it has excellent average power capability. It permits deep UV generation, and has great potential for generating tunable visible and IR light as an optical parametric amplifier.

39235 Reduction of stored energy in a heavily irradiated ceramic. Klemens, P.G.; Clinard F.W. Jr.; Livak, R.J. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **62**: No. 5, 2062-2064(1 Sep 1987).

The decrease of stored energy that accompanies redamage of a metamict ceramic is compared with the calculated elastic strain energy resulting from the volume misfit between the disordered inclusions and the crystalline matrix. In the case of self-damaged $CaPuTi_2O_7$ it is found that the elastic energy contributes no more than 20% to the observed energy decrease. The major part of this decrease must be attributed to rearrangement of atoms by the redamage process into configurations of lower energy.

39236 Preparation of single crystals of superconducting $YBa_2Cu_3O_7$/sub -//sub x/ from CuO melts. Damento, M.A.; Gschneidner K.A. Jr.; McCallum, R.W. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Applied Physics Letters;* **51**: No. 9, 690-691(31 Aug 1987). Contract W-7405-ENG-82.

Millimeter size single crystals of superconducting YBa_2Cu_3O/sub 7-//sub x/ (T/sub c/ —90 K) were grown by melting a mixture of stoichiometric YBa_2Cu_3O/sub 7-//sub x/ plus excess CuO at 1150 °C followed by holding at 900 °C for four days. Crystals were in the form of plates with c axis normal to the plate face. Growth of the crystals is believed to be aided by a liquid phase which is present at the holding temperature.

39237 Electronic structure and properties of d- and f-shell-metal compounds. Harrison, W.A.; Straub, G.K. (Department of Applied Physics, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 5, 2695-2706(15 Aug 1987).

Bonding in rock-salt—structure compounds is described. For NaCl, the bonding is in terms of electrons occupying chlorine p bands, lowered in energy by interaction with the sodium s states, and an overlap repulsion arises from nonorthogonality of states on neighboring ions. For transition-metal compounds d-like states are added, with their coupling with the nonmetallic p states. This coupling is taken to be of the form eta/sub p//sub d//sub m/h-dash-bar^2(r/sub p/r/sub d/^{3})/sup 1/2//(md^4), with r/sub p/ and r/sub d/ tabulated for each element. An additional overlap repulsion, proportional to h-dash-bar^{2}r/sub p/r/sub d/^{3}/(md^6) and to the number of electrons occupying the corresponding bands, also arises from this interaction. The simplest systems, such as KF, CaO, ScN, and TiC, contain eight valence electrons per atom pair and all but TiC are insulating. The extra energy from the covalent pd coupling is calculated; it decreases the lattice distance and increases the cohesion and bulk modulus. With a total valence of 9—12, the excess electrons occupy nonbonding bands making the compound metallic, but not significantly modifying the bonding properties.

39238 CdTe thermal parameters studied by single-crystal x-ray diffraction. Horning, R.D.; Staudenmann, J.h. (Department of Physics, Ames Laboratory and Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 5, 2873-2874(15 Aug 1987).

In an earlier paper [Phys. Rev. B 34, 3970 (1986)], the temperature-dependent results of thermal-vibration x-ray studies on a (001)= CdTe crystal have been reported. This note supplements the results mentioned above with additional temperature-dependent data taken on a (111) crystal. CdTe has a zinc-blende structure with a cubic lattice parameter of 6.482 A. With the use of both the (001) and (111) sets of data, an x-ray Debye temperature of FTHETA/sub M/ = 141 +- 2 K and a harmonic one-particle potential parameter α = 1.43 +- 0.06 eV/A^2 have been found. Harmonic thermal parameters for the individual Cd and Te atoms yield FTHETA/sub M//sub ,Cd/ = 134 +- 3 K and FTHETA/sub M//sub ,Te/ = 146 +- 3 K. Anharmonic parameters could not be accurately determined.

39239 Magnetic excitations in the itinerant antiferromagnets Mn_3Si and Fe-doped Mn_3Si. Tomiyoshi, S.; Yamaguchi, Y.; Ohashi, M.; Cowley, E.R.; Shirane, G. (Research Institute for Iron, Steel and Other Metals, Tohoku University, Sendai 980, Japan). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 4, 2181-2189(1 Aug 1987).

Magnetic excitations in the itinerant antiferromagnets Mn_3Si and Fe-doped Mn_3Si have been measured at low temperatures by inelastic scattering of neutrons. Mn_3Si is an incommensurate antiferromagnetic with magnetic Bragg points of the form (h,k,l) +- (δ,δ,δ) with δ = 0.425. Fe-doped Mn_3Si is a commensurate antiferromagnet with δ = (1/2. Its low-energy magnetic excitations have a linear dispersion relation with a slope of approximately 30 meV A, but above 6 meV, the slope increases so that the "cone" of the dispersion relation becomes a "chimney." Well-defined excitations have been observed at energies up to 7.5k/sub B/T/sub N/ (15 meV). In pure Mn_3Si, a similar dispersion cone exists around each satellite magnetic Bragg point with a slope of approximately 37 meV A. The two dispersion cones from a pair of satellite points intersect at about 5 meV. Above this energy the intensity of the inelastic peaks changes drastically, indicating a strong interaction between the cones. For both phases, the damping is very large and increases almost linearly with energy.

39240 Magnetic and superconducting properties of RBa_2Cu_3O/sub x/ compounds. Brown, S.E.; Thompson, J.D.; Willis, J.O.; Aikin, R.M.; Zirngiebl, E.; Smith, J.L.; Fisk, Z.; Schwarz, R.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 4, 2298-2300(1 Aug 1987).

Specific-heat and dc magnetic-susceptibility measurements have been performed on RBa_2Cu_3O/sub x/ (R denotes rare earth) compounds. These measurements show that the rare-earth atoms behave as local moments above the superconducting transition temperature of these compounds which can be as high or higher than in nonmagnetic YBa_2Cu_3O/sub x/. Further, we find coexistence of superconductivity and magnetism in R = Gd, Er, and Dy compounds and evidence for crystalline-electric-field splittings in these materials.

39241 **Magnetic fluctuations and two-dimensional ordering in $ErBa_2Cu_3O_7$.** Lynn, J.W.; Li, W.; Li, Q.; Ku, H.C.; Yang, H.D.; Shelton, R.N. (Department of Physics, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2374-2377(1 Aug 1987).

Neutron-diffraction and small-angle scattering techniques have been used to study the magnetic properties of $ErBa_2Cu_3O_7$. Below the superconducting transition of 95 K there is a decrease in the small-angle scattering, which has the correct amplitude, temperature dependence, and q dependence to be interpreted as the screening of the paramagnetic fluctuations by the superconducting electrons. At low temperatures (—1/2 K) the Er moments become ordered two dimensionally, with chains of spins coupled ferromagnetically, while adjacent chains align antiparallel.

39242 **Anisotropy of H/sub c/$_2$ and the breadth of the resistive transition of polycrystalline YBa_2Cu_3O/sub 7-//sub x/ in a magnetic field.** Welch, D.O.; Suenaga, M.; Asano, T. (Materials Science Division, Brookhaven National Laboratory, Upton, New York, 11973). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2390-2393(1 Aug 1987).

Measurements of the resistive transition in a magnetic field of a polycrystalline sample of the high-T/sub c/ superconducting oxide YBa_2Cu_3O/sub 7-//sub x/ were used, together with a theoretical analysis based on the anisotropic Ginzburg-Landau theory of the upper critical field H/sub c/$_2$ and the Davidson-Tinkham equation for the resistivity of a heterogeneous aggregate of superconducting and normal crsytallites, to obtain values of H/sub c/$_2$, in the temperature range 83—93 K, for fields parallel and perpendicular to the copper-oxygen layers. The anisotropy ratio for H/sub c/$_2$ is found to be in the range of 25—50.

39243 **Heat capacity of YBa_2Cu_3O/sub 7-//sub δ/ at the superconducting transition temperature.** Nevitt, M.V.; Crabtree, G.W.; Klippert, T.E. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2398-2400(1 Aug 1987).

Our heat-capacity measurements on a well-characterized sample of YBa_2Cu_3O/sub 6.85/ yield ΔC/sub p//T/sub c/≅20 mJ (mole Cu)/sup -1/ K/sup -2/, essentially the same value found previously for La/sub 1.85/Sr/sub 0.15/CuO_4. We combine this finding with independently estimated values of γ, the electronic specific-heat coefficient, to show that $\beta = \Delta C/\text{sub } p//\gamma T/\text{sub } c/$ is (1) well outside the weak-coupling regime (β/sub BCS/ = 1.43) for the Y-based compound (T/sub c/ = 93 K) and La-based compound (T/sub c/ = 31 K), and (2) larger by about a factor of 2 in the Y-based compound compared to the La-based compound, the latter having a β value in the same numerical range (2—3) as previously studied strong-coupling superconductors.

39244 **Dynamical evidence of hydrogen sublattice melting in metal-hydrogen systems.** Barnes, R.G.; Borsa, F.; Jerosch-Herold, M.; Han, J.W.; Belhoul, M.; Shinar, J.; Torgeson, D.R.; Peterson, D.T.; Styles, G.A.; Seymour, E.F.W. (Ames Lab., IA, USA; Warwick Univ., Coventry, UK. Dept. of Physics). *Journal of the Less-Common Metals;* **129**: vp(15 Feb 1987). (CONF-8605114—). Contract W-7405-ENG-82.

From Properties and applications of metal hydrides; Maubuisson, France (25 May 1986).

Measurements of the temperature dependence of the proton and deuteron spin-lattice relaxation time T/sub 1/ in cubic structure dihydrides and dideuterides (MH/sub 2/ and MD/sub 2/) (ScH/sub 1.83/,YH/sub 1.98/,ScD/sub 1.82/,YD/sub 1.88/) show a second high temperature turndown in T/sub 1/ in addition to the usual minimum associated with the independent hopping motion of H(D) among tetrahedral (T) interstitial sites at lower temperatures. The close analogy to the motion of anions in fluorite structure superionics suggests that the high temperature minimum indicates the onset of strongly correlated hydrogen motion, possibly accompanied by the occurrence of long-lived hydrogen clusters. (orig./GSCH).

39245 **Processing and creep performance of SiC-whisker-reinforced Al/sub 2/O/sub 3/.** Porter, J.R.; Lange, F.F.; Chokshi, A.H. (Rockwell International Science Center, Thousand Oaks, CA 91360). *American Ceramic Society Bulletin;* **66**: No. 2, 343-346(Feb 1987).

A procedure for processing SiC-whisker-reinforced Al/sub 2/O/sub 3/ has been developed which enables composites with good strength and creep properties to be fabricated. The procedure involves mixing components as dispersed slurries, press filtration of the slurries to produce green bodies, and hot pressing the green bodies in close fitting graphite dies. The resulting composites exhibit homogeneous microstructures and have high strength, high toughness, and high creep ductility.

39246 **Fiber-reinforced SiC composites with improved mechanical properties.** Caputo, A.J.; Stinton, D.P.; Lowden, R.A.; Besmann, T.M. (Oak Ridge National Lab., Metals and Ceramics Div., Oak Ridge, TN 37831). *American Ceramic Society Bulletin;* **66**: No. 2, 368-372(Feb 1987).

Continued development of ceramic-ceramic composites has produced SiC-reinforced SiC composites with enhanced physical and mechanical properties. Composites have been produced with exceptional strain tolerance (strain gage derived) and fracture toughness values which are significantly higher than those of non-reinforced SiC. Flexural strengths at both room temperature and at elevated temperatures also are presented.

39247 **Better ceramics through chemistry II; Proceedings of the Symposium, Palo Alto, CA, Apr. 15-19, 1986.** Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). 846p. (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The present conference treats topics in the fields of solution chemistry and synthesis for gels and powders, the characterization of chemically derived ceramics, gel drying and consolidation, the structures of random and ordered systems, nonoxide compositions, the comparative features of chemically and conventionally derived ceramics, the applications of molecular orbital/molecular dynamic calculations, materials for electronic packaging, and some novel materials. Attention is given to a molecular building block approach to the synthesis of ceramic materials, theoretical models for the precipitation of monodisperse ceramics, kinetic investigations of alkoxysilane sol-gel processing, the chemical route to aluminosilicate gels, glasses, and ceramics, fractal aspects of ceramic synthesis, organometallic precursors to aluminum nitride, a theory of silanol polymerization, the dispersion of ceramic particles in organic liquids, and the dielectric properties of sol-gel silica glasses.

39248 **Raman spectra of rings in silicate materials.** Tallant, D.R.; Bunker, B.C.; Brinker, C.J.; Balfe, C.A. (Sandia National Labs., Albuquerque, NM). pp 261-268 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Raman spectroscopic studies on gel-derived silicates have confirmed that narrow bands near 607 cm-1 and 492 cm-1, first observed in the Raman spectrum of fused silica, are associated with three- and four-fold siloxane rings. Using these results, the authors have identified three- and four-fold siloxane rings in other high-surface-area silica materials, including leached glasses and Cab-O-Sil. This Raman spectroscopic evidence not only shows that small siloxane rings are a common characteristic of a number of silica materials but also suggests that they form preferentially at silica surfaces. This paper reviews the Raman spectroscopic evidence that led to the identification of the vibrational frequencies of the small siloxane rings and presents the results of Raman experiments on high-surface-area silica materials in which the concentration of small siloxane rings is enhanced compared to fused silica.

3606 Other Materials

REFER ALSO TO CITATION(S) 38603, 38603, 38710, 38867, 38882, 38981, 39233, 39237, 39317, 39357, 39366, 39411, 39583, 39896

39249 (AD-A—179749/7/XAB) Electron-channeling radiation from diamonds with and without platelets. Park, H.; Kephart, J.O.; Klein, R.K.; Pantell, R.H.; Berman, B.L. (Stanford Univ., CA (USA). Solid-State Electronics Labs.). 1 Mar 1985. 5p. NTIS, PC A02/MF A01.

Pub. in J. of Applied Physics, Vol. 57, No. 5, 1661-1664(1 Mar 1985).

Channeling-radiation spectra produced by planar-channeled, 30.5- MeV electrons in Type-Ia and Type-IIa natural diamonds were measured and are compared with previous results for 54.5-MeV electrons. Because of the presence of platelets precipitated along the (100) planes in the Type-Ia diamond, the energies of the (100) spectral peaks are shifted downward relative to those for the Type-IIa diamond. The authors developed a model to explain this effect.

39250 (AD-A—179751/3/XAB) Channeling-radiation measurements at Lawrence Livermore National Laboratory. Berman, B.L.; Dahling, B.A.; Datz, S.; Kephart, J.O.; Klein, R.K. (Stanford Univ., CA (USA). Solid-State Electronics Labs.). 1985. 8p. NTIS, PC A02/MF A01.

Pub. in Nuclear Instruments and Methods in Physics Research, No. B10/11, 611-617(1985).

In the past few years, the amount and quality of channeling radiation data have increased enormously, owing largely to much-improved experimental capabilities. Current results include improved interplanar potentials for diamond, the description of the effect of platelets in diamond as an average thermal vibration, an improved determination of the Debye temperature of silicon, an improved determination of the thermal-vibration amplitude of LiD, and the demonstration that LiF crystal structures can survive intense electron bombardment.

39251 (AD-A—179866/9/XAB) Dependence of electron planar channeling radiation upon lattice-vibration amplitude. Datz, S.; Berman, B.L.; Dahling, B.A.; Hynes, M.V.; Park, H. (Stanford Univ., CA (USA). Solid-State Electronics Labs.). 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Nuclear Instruments and Methods in Physics Research, Vol. B13, 19-22(1986).

The energies of photons arising from transitions between low-lying bound states of channeled electrons are sensitive to the lattice-vibration amplitude. It is shown that calculations incorporating accepted values of Debye temepratures for C (diamond), Si, Ge, and GaAs lead to excellent agreement with experiment for all cases, save Si. Channeling radiation data from Si are then used to derive a Debye temperature that is shown to be consistent with temperature-dependent measurements in both planar and axial channeling.

39252 (AD-A—179912/1/XAB) Transmission-electron-microscopy study of alumina-fiber-reinforced magnesium composite. Final report. Chin, E.S. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Jan 1987. 23p. (MTL-TR—87-7). NTIS, PC A02/MF A01.

A detailed microstructral analysis of alumina (FP) fiber-reinforced ZE41A magnesium composite was performed by means of transmission electron microscopy (TEM). Fifty-five vol.% FP fiber-reinforced ZE41A magnesium composite thin foils were prepared by methods of mechanical polishing and ion thinning. Three major areas of interest in the composite microstructure were studied; the filaments, the interface (fiber/matrix reaction zone), and the matrix. In addition, the effects of heat treatments at 450 C on the composite microstructure were investigated. It was found that the alumina/magnesium interface consisted of a thin layer of magnesium aluminum oxide spinel and relatively large magnesium oxide (MgO) particles. A concentric layer of magnesium alloy grains encircling the alumina the magnesium matrix microstructures. Upon heat treatment at 450 C for 95 hours, polygonization of the magnesium matrix occurred while the spinel interfacial layer grew with decreasing magnesium oxide particle size.

39253 (BNL—38944) In situ repair of deteriorated concrete in hydraulic structures. Webster, R.P.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Nov 1986. Contract AC02-76CH00016. 12p. (CONF-870946—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004607.

From 5. international congress on polymers in concrete; Brighton, UK (21 Sep 1987).

Presented are the results of a laboratory-scaled test program designed to experimentally evaluate new methods and materials for use in the in situ repair of cracked concrete hydraulic structures utilizing pressure injection and polymer impregnation repair techniques. In general, the test results indicate that pressure injection can be used to effectively restore and integrity of air-dried and water-saturated cracked concrete. Polymer impregnation can be used to improve the quality of the concrete surrounding the crack network. However, its effectiveness in sealing the crack network is dependent upon the viscosity of the impregnant being used. The two methods can be used in conjunction to effectively repair and improve the overall quality of the structure to be rehabilitated.

39254 (BNL—39823) Magnetic excitations in an itinerant electron antiferromagnet Cr_2As. Yamaguchi, Y.; Goldman, A.I.; Ishimoto, K.; Ohashi, M. (Tohoku Univ., Sendai (Japan). Research Inst. for Iron, Steel and Other Metals; Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 10p. (CONF-8704171—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010789.

From International symposium on magnetism of intermetallic compounds; Kyoto, Japan (20 Apr 1987).

Spin wave excitations in an itinerant electron antiferromagnet Cr_2As was measured using neutron spectroscopy. Magnon dispersion is linear to the reciprocal lattice vector for small q, and the slope is 125 and 185 MeV A along c- and a-axis, respectively. The slope is about two times larger than the value predicted from the molecular field theory.

39255 (BNL—39898) Exchange of bonded hydrogen in amorphous silicon by deuterium. Abeles, B.; Yang, L.; Leta, D.P.; Majkrzak, C.F. (Brookhaven National Lab., Upton, NY (USA); Exxon Research and Engineering Co., Annandale, NJ (USA)). Dec 1986. Contract AC02-76CH00016. 6p. (CONF-861207—110). NTIS, PC A02. File Number DE87011292.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

We show that bonded hydrogen in a-Si:H is readily exchanged by atomic deuterium when exposed to a deuterium plasma discharge. The effective diffusion coefficient for the D,H exchange 10^{-14} cm^2/sec at 160°C, is comparable to that of interstitial hydrogen in c-Si.

39256 (CONF-870776—1) Experimental and theoretical analysis of backscattering mechanisms in fiber-reinforced composites. Roberts, R.A.; Qu, J.; Achenbach, J.D. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Technological Inst.). Apr 1987. Contract W-7405-ENG-82;W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011394.

From Symposium on acousto-ultrasonics; Blacksburg, VA, USA (12 Jul 1987).

This paper examines experimental measurements of polar backscatter following the techniques first employed by Bar-Cohen and Crane, and later by others. Experimental measurements of the angular dependence of ultrasonic backscatter are presented for fiber reinforced composite specimens (epoxy-carbon fiber) containing various levels of porosity. This data demonstrates how backscattered signals from porosity are inseparably intertwined with signals scattered by the internal fiber-related structures of the composite.

39257 **(CONF-870873—1) Fast neutron damage studies of La/sub 1.85/Sr/sub 0.15/CuO_4.** Sekula, S.T.; Christen, D.K.; Kerchner, H.R.; Thompson, J.R.; Boatner, L.A.; Sales, B.C. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). Apr 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. File Number DE87009820.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The effect of fast neutron damage on the superconducting transition temperature T/sub c/ and the critical current density j/sub c/ of the compound La/sub 1.85/Sr/sub 0.15/CuO_4 has been investigated. Irradiation to a fluence of 1.3 x 10^{18} n/cm^2 (E > 0.1 MeV) resulted in a decrease of T/sub c/ of about 3 K while j/sub c/ at 4.2 K and H = 2 T increased by a factor of two to 1.2 x 10^4 A/cm^2.

39258 (CONF-8610274—Absts., pp 9) **Reinforced DAPLEN polypropylene types - new materials made to measure.** Neissl, W. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

39259 **(DOE/ER/10348—9) Magnetic measurements of the transuranium elements: Progress report, January 1, 1985-December 31, 1987.** Huray, P.G.; Nave, S.E. (Tennessee Univ., Knoxville (USA)). 1 Jul 1987. Contract AS05-79ER10348;AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012475.

Highlights are given of research performed on CmBi, californium oxides, californium monopnictides, intermediate coupling calculations and californium trichlorides. We have recently made the first magnetic measurements on single crystals of transplutonium actinides.

39260 **(DOE/ER/45077—2) Spectroscopic investigations of glass structure: Progress report for the period December 1, 1984-November 30, 1985.** White, W.B. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 1 Dec 1985. Contract FG02-84ER45077. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012859.

This research is concerned with the structure and properties of insulator glass, particularly that modified by transition metal ions. Progress is reported under the headings: structure of host glasses (alkali ions, alkaline earths, high pressure, Raman spectra of defects), transition metal ions in glasses and melts (Cr in alkali borate glass, luminescence of Fe^{3+} activated aluminosilicate glasses), and theoretical studies (fractal character of glasses and amorphous solids). (DLC)

39261 **(EGG-M—35686) Wetting of silicon carbide surfaces by MgO-Li_2O-Al_2O_3-SiO_2 glasses.** Coon, D.N.; Neilson, R.M. Jr. (EG and G Idaho, Inc. Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 22p. (CONF-870422—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012432.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

Glass compositions in the MgO-Li_2O-Al_2O_3-SiO_2 system can be designed with melting temperatures less than 1200°C. Such glass systems wet SiC surfaces with equilibrium contact angles between 30 and 50° observed at temperatures between 950 and 1150°C. Glass compositions low in MgO and Al_2O_3 resulted in lower equilibrium contact angles and, hence, larger expected adhesive energies at test temperatures just above the melting point.

39262 **(K/ETAC—22) Failure analysis of ETAC [Enrichment Technology Applications Center] pressure vessel.** Frame, B.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012451.

This report presents the results of an investigation into the failure of a graphite-epoxy composite cylinder. It investigates the quality of the as-fabricated cylinder and provides a verification of compressive material property input used in its design. The design is reevaluated in terms of the adjusted composition and material property input for its suitability for 18,000-psi pressure applications. A comparison between the composition and layup of a cylinder manufactured by Hitco is also provided, as well as the results of a pressurization test of an identical ETAC cylinder tested by the Naval Ocean Systems Center.

39263 **(KFK—4169) Progress in composites: Microstructure-thermomechanical-property correlations of two-phase and porous materials.** Ondracek, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Oct 1986. 35p. NTIS, PC E07; Available from NTIS as TIB/B87-06275.

The paper basically deals with the aim, to a get a better scientific insight into the effects of microstructure and properties of multi-phase and porous materials and to use the results technologically for tailoring those materials. First the theory of microstructure-property correlations including both, the bound concept and the model concept, is described using conductivity and Youngs modulus of elasticity as property examples. Since in the frame of the theoretical derivation no fitting factors have been permitted to be introduced into the bound equations and constitutive equations the determination of the microstructural factors by quantitative microstructural analysis is demonstrated in the second part of the contribution. By comparing measured and calculated property values for porous ceramics, graphite and metals as well as cermets, metal-polymer and polymer-ceramic-composites the equations are tested for engineering conditions. Finally the dependences of the thermal conductivity and Youngs modulus of elasticity on porosity are used to predict the thermal shock resistance of porous glass and to compare the results with experimental values.

39264 **(NP—7770154) Time control of binder systems based on deep drilling and blast furnace cements.** Struth, R. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). Sep 1984. 229p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770154.

This paper examines binder systems, in which important properties such as flow, compressive strength under single axis and multi-axis loads, porosity and structure and corrosion resistance were improved by suitable controls. The investigations refer to 1. filling underground spaces and 2. on annulus cementation in deep drilling.

39265 **(SAND—87-0915C) Shock-induced chemical synthesis of barium ferrites.** Morosin, B.; Graham, R.A.; Venturini, E.L.; Carr, M.J.; Williamson, D.L. (Sandia National Labs., Albuquerque, NM (USA); Colorado School of Mines, Golden (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870753—23). NTIS, PC A02. File Number DE87012133.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Various mixtures of BaO, ZnO, and α-Fe_2O_3 have been subjected to a wide range of shock-loading conditions in order to determine parameters leading to shock-induced chemical synthesis of hexagonal ferrites of the type $BaFe_{12}O_{19}$, $BaZnFe_{14}O_{23}$, $BaZn_2Fe_{16}O_{27}$ and $BaZn_3Fe_{18}O_{31}$. Recovered samples show new x-ray diffraction lines consistent with the formation of new compounds, but not the desired hexagonal ferrites. In addition broadened lines for the unreacted oxides, as expected from our previous shock modified materials studies, were seen.

39266 **(SAND—87-0933C) Hydrostatic pressure studies of polyvinylidine fluoride (PVDF) and its copolymers.** Samara, G.A.; Bauer, F. (Sandia National Labs., Albuquerque, NM (USA); Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012136.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The frequency, temperature and hydrostatic pressure (≦10 kbar) dependences of the dielectric properties, molecular relaxations and phase transitions in PVDF and a copolymer with a 30% trifluorethylene were investigated. For the copolymer, both the ferroelectric transition (T/sub c/) and dynamic melting (T/sub m/) temperatures exhibit large increases with pressure. PVDF itself does not exhibit a T/sub c/ below T/sub m/, but its T/sub m/ also shows a large increase with pressure. The pressure and frequency dependences suggest an explanation for why it is possible to use these polymers as piezoelectric shock wave gauges to relatively high shock pressures.

39267 **(SAND—87-1656C) Electronic transport properties of hot-pressed B_6Si.** Wood, C.; Emin, D.; Feigelson, R.S.; Mackinnon, I.D.R. (Jet Propulsion Lab., Pasadena, CA (USA); Sandia National Labs., Albuquerque, NM (USA); Stanford Univ., CA (USA); New Mexico Univ., Albuquerque (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870438—30). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012017.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Measurements of the electrical conductivity, Seebeck coefficient and Hall mobility from ~300 K to ~1300°K have been carried out on multiphase hotpressed samples of the nominal composition B_6Si. In all samples the conductivity and the p-type Seebeck coefficient both increase smoothly with increasing temperature. By themselves, these facts suggest small-polaronic hopping between inequivalent sites. The measured Hall mobilities are always low, but vary in sign. A possible explanation is offered for this anomalous behavior.

39268 **(UCID—21105) Definition of a measure of material dispersity in low density materials.** Christensen, R.M. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012572.

A definition is given of material dispersity for low density materials which reflects the scale of material distribution in three-dimensional space. The measure of dispersity involves both cell size and cell type. The closed cell type is shown to provide a finer scale of material distribution than does the open cell type. A trade off between cell size and cell type is quantified.

39269 **(Y/DV—605/R2) Plasma-polymerized coatings on various substrates.** Weatherspoon, K.A.; Wilkerson, M.H. (Oak Ridge Y-12 Plant, TN (USA); Los Alamos National Lab., NM (USA)). 1 Jul 1987. Contract AC05-84OS21400. 24p. (CONF-870436—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012329.

From 14. annual national organization for professional advancement of black chemists and chemical engineers; San Francisco, CA, USA (13 Apr 1987).

Plasma polymerized coatings can possibly be used to provide protection for moisture-sensitive substrates such as lithium hydride and depleted uranium. Paraxylene, benzene, perfluoro-2-butene, tetrahydrofuran, and other monomers have been used to deposit plasma polymerized coatings on these substrates. Coatings on glass slides, other metals, and glass microballoons have yielded additional information on the plasma polymerization process in general.

39270 **Second-harmonic generation in sodium lanthanium fluoride.** Velsko, S.P.; Eimerl, D. (Nonlinear Optical Materials Group, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 6, 2461-2465(15 Sep 1987). Contract W-7405-ENG-48.

Sodium lanthanum fluoride ($NaLaF_4$) is a new nonlinear fluoride crystal that can be phase matched at 1.06 μm. It has an unusually small angular sensitivity for a critically phase-matchable material (800 cm^{-1}/rad). Its nonlinear coefficients are at least 5 times larger than those of $BaZnF_4$ and twice as large as those of Na_2SbF_6, the only other fluorides known to be phase matchable at 1.06 μm. This paper describes measurements of phase-matched second-harmonic generation in small (submillimeter) crystals and discusses the relationship of the observed nonlinear properties of the unusual structure of this crystal.

39271 **Raman spectra and phase diagram of fluorine at pressures up to 6 GPa and temperatures between 10 and 320 K.** Schiferl, D.; Kinkead, S.; Hanson, R.C.; Pinnick, D.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 5, 3016-3021(1 Sep 1987). Contract W-7405-ENG-36.

The Raman spectra and phase diagram of fluorine were studied in a diamond-anvil cell up to 6 GPa over the temperature range 10—300 K. The sample slowly reacted with the diamond anvils to form CF_4. The vibron frequencies in α-F_2 and β-F_2, as well as the lattice modes in α-F_2, were determined as a function of pressure. No new phases were discovered. The α—β phase boundary can be fit with an equation of the Simon form: P/sub α//sub β/ (GPa) = -0.385(10) +4.80(9) x 10^{-4} T/sub α//sub β//sup 1.75/ (K). The melting curve was established to lie between limiting curves: P/sup upper//sub melt/ (GPa) = -0.107+1.01 x 10^{-4}T/sup 1.75//sub melt/ (K) and P/sup lower//sub melt/ (GPa) = -0.140+1.32 x 10^{-4} T/sup 1.75//sub melt/ (K).

39272 **Appropriate use of the strength parameter in solid-state slab laser design.** Marion, J.E. (Lawrence Livermore National Laboratory, L-490, P. O. Box 5508, University of California, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 5, 1595-1604(1 Sep 1987). Contract W-7405-ENG-48.

The manner in which the strength parameter is used in the design process for high-average-power slab lasers is examined. Fracture toughness, an intrinsic measure of the strength of brittle materials, is adopted as the appropriate parameter for comparison of different materials in a selection process. Conversely, an estimate of actual component strength is used in fixing a safe operating stress for the laser by a weibull scaling of fracture data. Measurement methods for characterizing these two strength parameters are examined for both laser glasses and crystals. Experimental results illustrating these techniques are given.

39273 **Properties of carbon clusters in TNT detonation products: Graphite-diamond transition.** van Thiel, M.; Ree, F.H. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 5, 1761-1767(1 Sep 1987). Contract W-7405-ENG-48.

The thermodynamic properties of condensed carbon in the detonation products of TNT have been analyzed with a statistical mechanical model. The calculations show that the heat of formation of diamondlike particles in detonation products is increased by 1—2 kcal/mol (0.04—0.08 eV), relative to that of the graphitic or carbynelike low-pressure phase. The density of the low-pressure phase also appears to be about 10% higher than that of graphite. The short condensation times of 10^{-7}—10^{-8} s suggest carbon clusters with a high surface energy. The heat of formation indicates cluster sizes of about 100 A.

39274 **Compressive epitactic layers on single-crystal components for improved mechanical durability and strength.** Marion, J.E.; Gualtieri, D.M.; Morris, R.C. (Lawrence Livermore National Laboratory, L-490 University of California, P.O. Box 5508, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 5, 2065-2069(1 Sep 1987).

Compressive epitactic layers grown on single-crystal substrates are shown to substantially improve mechanical durability. In this study, neodymium-substituted gadolinium gallium garnet (GGG) layers are grown on undoped GGG substrates. The layers are found to dramatically improve the abrasion resistance of the substrates, but to have only a slight effect on strength. Abrasion treatments, which cause up to 20 times decrease in the strength of substrates without epitactic layers, do not cause a significant decrease in the strength of substrates with these compressive surface layers. This permits the high strength of specially prepared strong substrates to be retained after abrasion.

39275 **Comparative study of phase stability and film morphology in thin-film M/GaAs systems (M = Co, Rh, Ir, Ni, Pd, and Pt).** Sands, T.; Keramidas, V.G.; Yu, K.M.; Washburn, J.; Krishnan, K. (Bell Communications Research, Inc., 331 Newman Springs Road, Red Bank, New Jersey 07701). *Journal of Applied Physics;* **62**: No. 5, 2070-2079(1 Sep 1987).

To attain reproducible and stable contacts to compound semiconductor devices, it is necessary to achieve thermodynamically stable phases after the reaction of metals with the compound semiconductor. In this study, the final phases produced by the reactions between GaAs and thin metal films of Co, Rh, Ir, Ni, Pd, and Pt have been investigated. They are identified as MGa for M = Co, Rh, Ni, Pd, and Pt, monoarsenides of Co and Ni, diarsenides of Rh, Ir, Pd, and Pt, and Ir_3Ga_8. These phases, if deposited directly onto GaAs, will produce thermally stable contacts. In addition to the identification of these stable phases, analyses of the products of thin-film M/GaAs reactions by transmission electron microscopy, x-ray diffraction, and Rutherford backscattering spectrometry reveal the distribution, grain size, and crystallographic texture of these end phases. Trends in these observations across the six metal/GaAs reactions studied are explained by considering the effects of bond strength and the relative diffusivities of the reacting species. The role of film thickness in determining the final phases and the phase distribution is also considered.

39276 **Device quality growth and characterization of (110) GaAs grown by molecular beam epitaxy.** Allen, L.T.P.; Weber, E.R.; Washburn, J.; Pao, Y.C. (Department of Materials Science and Mineral Engineering, University of California at Berkeley, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 9, 670-672(31 Aug 1987).

Device quality (110)GaAs has been reproducibly grown by molecular beam epitaxy (MBE) for the first time. Angling of the substrate to expose stable, Ga-rich ledges on the (110) surface has been shown to be the necessary condition for two-dimensional growth. The layers exhibit a room-temperature electron mobility of —5700 cm^2/V s for N/sub Si/—4 x 10^{15} and a strong exciton photoluminescence emission at 4 K. This breakthrough in MBE growth of III-V compounds allows for fabrication of (110) GaAs devices which will take advantage of the unique properties of this orientation.

39277 **Photoluminescence microscopy of epitaxial GaAs on Si.** Gourley, P.L.; Longerbone, M.; Zhang, S.L.; Morkoc, H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 8, 599-601(24 Aug 1987). Contract AC02-76ER01198.

We report microscopic photoluminescence images and corresponding spectra of epitaxial GaAs on Si substrates, prepared by molecular beam epitaxy. High magnification (3000 x) images directly reveal dislocations present in the epilayer. Several substrate orientations are investigated including nominal (001) tilted 4° toward <110>. The GaAs samples include structures grown with and without superlattice buffer layers. Some samples were annealed at several temperatures from 650 to 850 °C. The dislocation density versus depth is studied by varying the optical probe wavelength and by studying samples that had been beveled and etched. In addition, the images and spectra are studied over a wide temperature range.

39278 **Novel oxidation process in Ge^+-implanted Si and its effect on oxidation kinetics.** Holland, O.W.; White, C.W.; Fathy, D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Applied Physics Letters;* **51**: No. 7, 520-522(17 Aug 1987). Contract AC05-84OR21400.

Thermal oxidation of Si is shown to be substantially affected by the implantation of Ge^+ ions. A unique morphology develops during steam oxidation due to the rejection of Ge from the oxide at the growth interface. The Ge pile-up leads to the formation of a distinct layer of almost pure Ge between the oxide and the underlying Si. Oxidation rates are enhanced due to the presence of this film which is shown to increase the interfacial reaction rate. This increase is attributed to a decrease in the binding energy of Si atoms at the interface as a result of alloying with the Ge film. A model is proposed to account for the enhanced oxidation kinetics and is shown to be in good agreement with experimental data.

39279 **Temperature-dependent damage production in ion-implanted strained-layer superlattices.** Myers, D.R.; Arnold, G.W.; Dawson, L.R.; Biefeld, R.M.; Hills, C.R.; Doyle, B.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 7, 517-519(17 Aug 1987). Contract AC04-76DP00789.

We have characterized damage production in both (InGa)As/GaAs and Ga(AsP)/GaP strained-layer superlattices (SLS's) for fluences sufficient to induce compositional disordering at three different implant temperatures. Dramatically different implant temperatures are required to produce similar defect distributions between the two SLS systems. Implants at lower temperatures [80 K for the (InGa)As/GaAs system, 300 K and below for the Ga(AsP)/GaP system] exhibit amorphous zones at depths consistent with the predictions of ion range codes; while implants at elevated temperatures [25°C in (InGa)As/GaAs, 400°C in the Ga(AsP)/GaP system] exhibit greatly reduced damage levels characterized mainly by extended defects.

39280 **Effects of compressive uniaxial stress on the electronic structure of GaAs-Ga/sub 1-//sub x/Al/sub x/As quantum wells.** Mailhiot, C.; Smith, D.L. (Xerox Webster Research Center, 800 Phillips Road, 0114-41D, Webster, New York 14580). *Physical Review [Section] B: Condensed Matter;* **36**: No. 5, 2942-2945(15 Aug 1987).

We present a theoretical analysis of the effects of compressive uniaxial stress on the electronic structure of GaAs-Ga/sub 1-// sub x/Al/sub x/As quantum wells grown along the [001] axis. Strain interactions are incorporated by use of known deformation potentials of the bulk semiconductors, and, therefore, our analysis contains no adjustable parameters. We consider the cases where the external uniaxial stress X is parallel (Xparallel[001]) and perpendicular (Xparallel[100]) to the [001] growth axis of the quantum well. Our results indicate that, unlike the bulk case, the strain-induced energy shifts depend sensitively on whether the compressive stress is applied along the [001] or [100] axis. These differences are a direct consequence of the mixing of the bulk heavy-hole and light-hole states by the strain interactions and by the quantum-well potential. For Xparallel[100], the strain-induced energy shifts associated with the heavy- and light-hole quantum-well states are strong nonlinear functions of the magnitude of the applied compressive stress due to the admixing by the strain Hamiltonian of the corresponding bulk states. However, for Xparallel[001], a strong nonlinear behavior is only predicted for the light quantum-well states due to the mixing between the bulk light and spin split-off states. The strain-induced energy shifts are dependent on the GaAs quantum-well thickness. The results of our analysis are in excellent agreement with experimental measurements of strain-induced energy shifts in quantum wells.

39281 **Inference of high atom densities in solid tritium for nuclear magnetic resonance measurements.** Gaines, J.R.; Sater, J.D.; Fearon, E.M.; Souers, P.C.; McMurphy, F.E.; Mapoles, E.R. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review Letters;* **59**: No. 5, 563-566(3 Aug 1987).

At fixed temperature the ortho concentration in solid T_2, as monitored by NMR, is found to decay exponentially in time with a time constant that has a minimum at 11.4 K. At 11.4 K the ortho to para conversion in T_2 is 200 times larger than in H_2. This enhanced conversion rate is attributed to diffusing atoms created by the tritium β decay. A hopping model is used to infer the atom number density and hopping frequency as functions of the temperature.

39282 **Nuclear-spin noise and spontaneous emission.** Sleator, T.; Hahn, E.L.; Hilbert, C.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 1969-1980(1 Aug 1987).

The spontaneous emission from nuclear spins has been observed at liquid-^{4}He temperatures. The spins, /sup 35/Cl nuclei, are placed in the inductor of a tuned LCR circuit coupled to a dc superconducting quantum interference device used as a radio-frequency amplifier. When the spins are saturated and have zero polarization, the emission is observed at the nuclear quadrupole Larmor

frequency as a bump in the spectral density of the Nyquist noise current in the tuned circuit. This bump arises from the temperature-independent fluctuations in the transverse component of the nuclear magnetization. When the spins are in thermal equilibrium, on the other hand, a dip in the spectral density of the current noise is observed, arising from an induced absorption of noise power from the circuit at the Larmor frequency. The standard circuit-coupled Bloch's equation, modified to take into account radiation damping and transverse spin fluctuations, is consistent with the predictions of the Nyquist theorem and the Einstein equation for spontaneous emission. A spin-pendulum model for spin noise is described. The signal-to-noise ratio obtainable in a spin-noise measurement is discussed.

39283 **Observation of spin diffusion in zero-field magnetic resonance.** Suter, D.; Jarvie, T.P.; Sun, B.; Pines, A. (Department of Chemistry, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 1, 106-108(6 Jul 1987). Contract AC03-76SF00098.

We report the measurement of spin diffusion at zero field, observed by two-dimensional deuterium magnetic resonance of a polycrystalline sample. This demonstrates for the first time an appealing feature of pulsed zero-field magnetic resonance, namely the potential for structure determination in solids without the need for single crystals or oriented samples.

39284 **Vortex signatures in dynamic structure factors for two-dimensional easy-plane ferromagnets.** Mertens, F.G.; Bishop, A.R.; Wysin, G.M.; Kawabata, C. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 1, 117-120(6 Jul 1987).

The XY and the anisotropic Heisenberg models are considered above the Kosterlitz-Thouless transition temperature. Under the assumption of a gas of freely moving vortices, it is shown that the dynamic structure factor exhibits a central peak for both in-plane and out-of-plane correlations, in good agreement with the results of a combined Monte Carlo—molecular dynamics simulation. These results are also consistent with recent neutron-scattering data on Rb_2CrCl_4 and $BaCo_2(AsO_4)_2$, which show qualitatively the same wave-vector and temperature dependences.

39285 **Calculation of the valence band offsets of common-anion semiconductor heterojunctions from core levels: The role of cation d orbitals.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **5**: No. 4, 1239-1245(Jul 1987). Contract AC02-77CH00178.

The valence band offsets of the common-anion CdTe—HgTe, CdTe—ZnTe, ZnTe—HgTe, and GaAs—AlAs semiconductor pairs are calculated from the core level energies. The good agreement obtained with experiment for lattice-matched systems and a simple electrostatic model analysis suggest interface dipoles to have only a small effect. Furthermore, the microscopic origin of the failure of the common-anion rule in lattice-matched systems is identified: it is found that participation of cation d orbitals (neglected by tight-binding and pseudopotential approaches alike) in the valence band maxima is responsible for much of the band offset in these systems.

39286 **X-ray topographic observations of crystal structure in silicon ribbons grown by various methods.** Ciszek, T.F. (Solar Energy Research Inst., Golden, CO, USA). *Journal of Crystal Growth;* **82**: No. 1/2, 182-190(Mar 1987). (CONF-8607331—). Contract AC02-83CH10093.

From 4. Hungarian conference on crystal growth (HCCG-4) with international participation and 1. international symposium on shaped crystal growth (SSCG-1); Budapest, Hungary (22 Jul 1986).

X-ray topography was used to examine dislocation distributions, grain boundary angles, twins, stacking faults, degree of long range order, and growth disruptions in silicon ribbons grown by the dendritic web method, edge-supported pulling, horizontal ribbon growth, and capillary-die meniscus shaping. The nearly single-crystalline structure of dendritic web ribbons allowed quantitative determination of the degree of residual lattice-plane bending due to thermal stresses. Correlations between dislocation structure and photovoltaic conversion efficiency were made for webs. A multicrystalline structure was observed in the other ribbons. The grains were mainly longitudinal, with varying amounts of long range order, and exhibited large differences in dislocation density.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

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39287 **(AAEC/M—113) PIXAN: the Lucas Heights PIXE analysis computer package.** Clayton, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1986. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702420.

To fully utilize the multielement capability and short measurement time of PIXE it is desirable to have an automated computer evaluation of the measured spectra. Because of the complex nature of PIXE spectra, a critical step in the analysis is the data reduction, in which the areas of characteristic peaks in the spectrum are evaluated. In this package the computer program BATTY is presented for such an analysis. The second step is to determine element concentrations, knowing the characteristic peak areas in the spectrum. This requires a knowledge of the expected X-ray yield for that element in the sample. The computer program THICK provides that information for both thick and thin PIXE samples. Together, these programs form the package PIXAN used at Lucas Heights for PIXE analysis.

39288 (AGARD-CP—99, pp vp) **Accurate measurements of combustion species concentrations using CARS.** Farrow, R.L. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Results are given of research at the Combustion Research Facility, Sandia National Laboratories, on improving the capabilities of Coherent Anti-Stokes Raman Spectroscopy (CARS) for species concentration measurements in combustion gases. Scanning CARS experiments based on single- and multi-mode Nd:YAG lasers, and on pulse-amplified and conventional pulsed dye lasers have been used to evaluate an in situ normalization technique, to measure Raman linewidths in flames, and to determine nonresonant electronic susceptibilities. Experimental and theoretical considerations affecting concentration measurement accuracy are discussed.

39289 **(BNL—40038) Neutron activation analysis in archaeological chemistry.** Harbottle, G. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012870.

Neutron activation analysis has proven to be a convenient way of performing the chemical analysis of archaeologically-excavated artifacts and materials. It is fast and does not require tedious laboratory operations. It is multielement, sensitive, and can be made nondestructive. Neutron activation analysis in its instrumental form, i.e., involving no chemical separation, is ideally suited to automation and conveniently takes the first step in data flow patterns that are appropriate for many taxonomic and statistical operations. The future will doubtless see improvements in the practice of NAA in general, but in connection with archaeological science the greatest change will be the filling, interchange and widespread use of data banks based on compilations of analytical data. Since provenience-oriented data banks deal with materials (obsidian, ceramics, metals, semiprecious stones, building materials and sculptural media) that participated in trade networks, the analytical data is certain to be of interest to a rather broad group of archaeologists. It is to meet the

needs of the whole archaeological community that archaeological chemistry must now turn.

39290 **(GSI—86-53-Prepr.) Recent developments in rapid radiochemical separations.** Herrmann, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). Dec 1986. 16p. (CONF-8609159—9-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-06465.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

The processes worked out and tested at the UNILAC heavy ion accelerator (at Darmstadt) for the separation of short-lived radio-isotopes of actinides and superheavy elements are described, from among the recently developed continuous processes for separation. For the transport of the radio-isotopes, a gas jet system is used, which transports the products online in a gas phase separation direction, where the super-heavy elements around element 114 (Eka-lead) are reduced to the elementary state and are released at high temperatures from non-volatile elements, such as actinides, for example. They are then separated on cooled detector foils and their spontaneous fission events are measured. Further separation processes were worked out for super-heavy elements similar to radon and similar to platinum. Fast liquid chromatography, gas chromatography and extraction processes, combined with the use of centrifuges for separating the two liquid phases, are described for trivalent heavy actinide elements.

39291 **(INIS-BR—621) Laser induced uranium fluorescence as an analytical method.** Krutman, I. (Sao Paulo Univ. (Brazil)). 1985. 49p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702458.

A laser induced fluorescence system was developed to measure uranium trace level amounts in aqueous solution with reliable and simple materials and electronics. A nitrogen pulsed laser was built with the storage energy capacitor directly coupled to laser tube electrodes as a transmission line device. This laser operated at 3Hz repetition rate with peak intensity around 21 Kw and temporal width of 4.5 x 10^{-9} s. A sample compartment made of rigid PVC and a photomultiplier housing of aluminium were constructed and assembled forming a single integrated device. As a result of this prototype system the authors made several analytical measurements with U dissolved in nitric acid to obtain a calibration curve. The obtained a straight line from a plot of U concentration versus fluorescence intensity fitted by a least square method that produced a regression coefficient of 0.994. The lower limit of U determination was 30 ppb /sup -+/ 3.5%.

39292 **(INIS-BR—635) Determination of rare earth elements and other trace elements in the BB-1 (granite) and GB-1 (basalt) Brazilian geologic standards by neutron activation analysis.** Marques, L.S.; Figueiredo, A.M.G. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—9-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702470.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39293 **(INIS-BR—643) Analytical aspects in uranium fluorimetric determination.** Pascholati, E.M.; Fujimori, K.; Hiodo, F.Y. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—17-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702478.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39294 **(INIS-mf—10678) Development of a mass spectrometrical isotope dilution analysis for determination of trace iodine levels and its application for food samples.** Schindlmeier, W. (Regensburg Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet 4 - Chemie und Pharmazie). 1984. 153p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-10161.

A mass spectrometrical isotope dilution procedure for the determination of trace amounts of iodine in various materials was developed using /sup 129/I as indicator isotope, based on the determination of the /sup 129/I//sup 127/I isotope relationship. Negative thermionization was used as ionization method. The analysis procedure, which worked with a standard deviation of between 0,1 and 10% (depending on material tested), was used to determine the iodine level of table salt - both iodized and normal salt (3-6 ppm and less than 0,006 ppm respectively), and food samples with an organic matrix. For comparison the iodine levels were also measured with an iodine-selective electrode. Special preparation and separation procedures were done to suit the sample material. A comparison of the levels of iodine concentration in various powdered milks which were measured by international collaborators using varying methods shows the superior reproducibility of the MS-IDA.

39295 **(ISH—101) First countercheck trial to identify irradiated spices with luminescence techniques.** Heide, L.; Delincee, H.; Demmer, D.; Schilling, M.; Eichenauer, D.; Grabowski, H.U. v.; Pfeilsticker, K.; Redel, H.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). Aug 1986. 127p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06451.

The Federal Health Office, in collaboration with 4 institutions responsible for food control analysis and 2 research facilities, for the first time conducted a countercheck trial to identify irradiated spices. This test was mainly intended to find out whether chemiluminescence (CL) and thermoluminescence (TL) techniques are appropriate for this purpose. Nine different spices were selected. Approximately 85% of the samples may be identified correctly if both methods are used. However, only 3% of all spices subjected to CL analysis were falsely identified as irradiated, and the proportion of falsely positive results is even lower than 1% if only those spices are considered for which CL analysis is well suited. If an additional procedure, such as TL, is applied, it is highly probable that false identification of non-irradiated samples may be excluded.

39296 **(LA—11076-MS) Quantification of americium by isotope dilution mass spectrometry.** Efurd, D.W.; Drake, J.; Roensch, F.R.; Miller, G.G.; Cappis, J.H.; Perrin, R.E. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012378.

A surface ionization-diffusion-type ionization source that uses a rhenium filament overplated with platinum has been developed and optimized for 0.01-ng americium samples. This source is capable of measuring the americium content of nuclear-test-debris samples to 0.20% precision at the 95% confidence level.

39297 **(PNL-SA—14688) New approaches to the supercritical fluid chromatography-mass spectrometry interface for analysis of nonvolatile materials.** Kalinoski, H.T.; Udseth, H.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 3p. (CONF-8705114—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012159.

From 35. conference on mass spectrometry and applied topics; Denver, CO, USA (24 May 1987).

Advantages of using polar fluid modifiers and pressure programming on packed microbore columns are shown, using a mixture of 8 organophosphorus pesticides.

39298 **(PNL-SA—14689) Capillary zone electrophoresis with on-line mass spectrometric detection.** Smith, R.D.; Olivares, J.A.; Nguyen, N.T. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 3p. (CONF-8705114—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012160.

From 35. conference on mass spectrometry and applied topics; Denver, CO, USA (24 May 1987).

Electrospray ionization provides an ideal interface for the marriage of a highly efficient separation technique, capillary zone electrophoresis, with the mass spectrometer. (DLC)

39299 (UCID—21094) Mixture resolution of chemical vapors using a piezoelectric multisensor array. Olness, D.U. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012915.

A good deal of work has been carried out in an effort to develop some means of detecting and confirming the identity of minute atmospheric concentrations of chemical vapors. A detector which appears to have the ultimate capability of achieving the sensitivity and specificity required to produce a reliable instrument free from interferences is the crystal sorption detector. The system operates by measuring the response, of a number of different coatings on piezoelectric crystals, to both toxic vapors and background vapors. We used an interpretation procedure on the array of frequency responses produced by the various layers to correctly identify a given vapor or class of vapors contained in a mixture of interfering background vapors.

39300 Antibody-based fiberoptics biosensor for the carcinogen benzo(a)pyrene. Vo-Dinh, T.; Tromberg, B.J.; Griffin, G.D.; Ambrose, K.R.; Sepaniak, M.J.; Gardenhire, E.M. (Advanced Monitoring Development Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6101 (T.V.-D., G.D.G., K.R.A.)). *Applied Spectroscopy;* **41**: No. 5, 735-738(Jul 1987). Contract AC05-84OR21400.

A new antibody-based fiberoptics biosensor was used to detect the important carcinogen benzo(a)pyrene (BaP). The fiberoptics sensor utilizes anti-BaP antibodies covalently bound to its tip. A helium cadmium laser was used as the excitation source to induce fluorescence from BaP conjugated to the bound anti-BaP antibodies. The fiberoptics device can detect 1 femtomole of BaP in a 5-μL sample drop.

39301 Study of internal standardization in inductively coupled plasma-mass spectrometry. Thompson, J.J.; Houk, R.S. (Ames Laboratory-U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Applied Spectroscopy;* **41**: No. 5, 801-806(Jul 1987). Contract W-7405-ENG-82.

Internal standardization is empolyed to compensate for ionization suppression in inductively coupled plasma-mass spectrometry (ICP-MS). By examination of the response of over 50 elements to a sodium matrix under different operating conditions, it is apparent than an internal standard is most effective when it is close in mass and ionization energy to the analyte. The extent of suppression and the relative order of suppression of various analyte elements can differ for various matrix elements. Generally, precision was improved by the use of internal standardization; the extent of improvement differed for different analyte elements and operating conditions. A comparison between ICP-MS with ultrasonic and pneumatic nebulization is described. The ultrasonic nebulizer usually exhibits better sensitivity and detection limits for analyte elements, unless the extent of suppression induced by the concomitant matrix is very high.

39302 Application of position-sensitive, photon-counting detectors in Raman spectroscopy. Veirs, K.; Chia, V.K.F.; Rosenblatt, G.M. (Lawrence Berkeley Lab., Materials and Molecular Research Div., MS 62-203, Berkeley, CA 94725). pp WA8.1-WA8.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

Raman spectroscopy has benefited from recent advances in the technology of lasers, optics, thin film interference filters and multichannel detectors. A new generation of imaging detectors based upon microchannel plates with position sensitive anodes may increase the sensitivity of Raman spectroscopy. Such detectors would be particularly useful to Raman spectroscopy without surface enhancement. A position-sensitive detector (PSD) with resolution of 70 microns in both the x and y axis on a 1 inch diameter photocathode with a dark count of 30 counts per second (CPS) was used. The signal and signal to noise ratio (SNR) of this detector was compared to the standard intensified photodiode array (IPDA) detector using the Raman spectra of the fundamental vibration of O/sub 2/ in air.

39303 Elemental analysis of metals at distances up to 2.4 meters using Laser-Induced Breakdown Spectroscopy. Cremers, D.A. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp WA4.1-WA4.2 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The laser spark has been used extensively in the laboratory to provide an elemental analysis of metals. This method, called Laser-Induced Breakdown Spectroscopy (LIBS), uses a laser spark to vaporize and excite a material. The spark light is then spectrally and temporally resolved, as in other methods of atomic emission spectroscopy, to determine the elemental composition. The method has many potential advantages over more common laboratory-based methods like atomic absorption spectroscopy and the inductively coupled plasma. These advantages include simplicity, minimal sample preparation, possibility of non-invasive and in-situ analysis, and rapid response. On the other hand, the accuracy and precision of LIBS measurements are generally inferior to the laboratory methods thereby cancelling somewhat the advantages of LIBS for routine analyses. Some field-based applications, however, a high degree of analytical performance may not be required. These include prospecting, industrial process control monitoring, and metal identification. The alloy sorting and identification of stockpiled metals, offers the best chance for immediate application and so has been examined in detail in this paper. The two main problem areas of LIBS for field-based analysis are reproducible spark generation and collection of the spark light. Because the spark is formed by focused laser pulses, the sample must be near the focal volume and ideally at the same position within the focal volume on each pulse for maximum reproducibility of the spectral signals. A simple LIBS-based apparatus which solves these problems has been constructed and tested for metal analysis.

39304 Spectrochemical analysis using degenerate four wave mixing. Ramsey, J.M.; Whitten, W.B. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831-6142). pp ThA7.1-ThA7.2 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—). Contract AC05-84OR21400.

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

Degenerate four-wave mixing, or DFWM, has been shown to have considerable potential as a technique for optical spectrometry. Spectral resolution comparable to the natural linewidth can be obtained for atomic vapor samples due to the Doppler free nature of the measurements. To the authors's knowledge, however, the applicability of the DFWM technique to trace elemental analysis has not been explored. In the past it was shown that DFWM can take place in an air-acetylene flame with sodium from an aspirated aqueous solution as the sample. However, they were attempting to show that DFWM could be used as a combustion diagnostic tool and involved measurements at relatively high concentrations. In this paper the authors present the results of a study of degenerate four-wave mixing in atomic sodium produced in an analytical flame.

39305 Differential thermooptic spectroscopy using the two-frequency, Zeeman effect laser. Johnston, R.G. (Experimental Pathology Group, Life Sciences Div., Los Alamos National Lab., MS M888, Los Alamos, NM 87545). pp WB3.1-WB3.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The two-frequency, Zeeman effect laser is an ideal interferometric tool. It permits simple instrumentation that is relatively insensitive to the thermal and mechanical instabilities usually associated with interferometry. The accuracy is also high. Changes of λ/1000 in the relative optical pathlengths of two samples can be read-

ily detected. (Optical Pathlength is defined as OPL = $\int n(x)\,dx$, where n(x) is the index of refraction as a function of position along a beam path. This resolution is at least a factor of 5 better than can routinely be achieved using conventional interferometric techniques. The scheme for differential thermooptic spectroscopy discussed here exploits the recent commercial availability of the Optralite two-frequency, Zeeman effect laser. This 1 mw He-Ne laser uses the Zeeman effect to produce two, collinear laser lines having orthogonal polarizations. The two lines, each near 632.8 nm, differ by only 250 kHz out of half a million GHz. The 250 kHz frequency difference is stable to 0.1 ppm.

39306 **Ionization suppression in ICP-MS: Theoretical and experimental studies.** Houk, R.S.; Crain, J.S. (Ames Lab.-USDOE). pp 171 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Several workers have reported that ICP-MS shows somewhat greater susceptibility to suppression of analyte ionization by concomitant elements than does ICP-AES. A simple mathematical model has been developed to study this phenomenon.

39307 **Sample preparation problems in inductively coupled plasma-optical emission spectrometry.** Larson, G.F.; Slagle, R.E. (Plant Lab., Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). pp 153 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—). Contract AC05-84OR21400.

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Inductively coupled plasma-optical emission spectrometry (ICP-OES) provides the analytical spectroscopist with a very powerful and versatile technique for the simultaneous determination of up to approximately 70 elements. The development of adequate dissolution techniques to match the versatility of ICP-OES or to fulfill the requirements of the analysis is frequently the most challenging step in the development of an ICP-OES procedure. In this presentation, problems encountered in the preparation of samples (e.g., steels, aluminum alloys, uranium, etc.) are discussed.

39308 **Another hydrofluoric acid resistant sample introduction system for the inductively coupled plasma.** Slagle, R.E.; White, L.E.; Larson, G.F. (Plant Lab., Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). pp 151 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—). Contract AC05-84OR21400.

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

A hydrofluoric-acid-resistant, sample-introduction system for the determination of silicon by inductively coupled plasma-optical emission spectrometry (ICP-OES) are described. The system has been in routine use for three years and requires only occasional replacement of a sapphire insert. Several problems and peculiarities encountered in the determination of minor and trace levels of silicon in a variety of samples are described.

39309 **Shielded plasma source as a new spectrochemical tool.** Bieniewski, T.M.; Hull, D.E. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 114-115 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

With the recent development of the shielded plasma source, a new experimental technique has emerged for totally vaporizing any inorganic sample directly into a plasma for spectrochemical or mass spectrometric analysis. This paper does indicate the potential of this plasma source for spectrochemical and mass spectrometric analysis. However, further development of the shielded plasma as an analytical tool still requires solving the intermittent crucible arcing problem and the establishing of the linearity and detection limits achievable by this technique.

39310 **Arc nebulization for direct analysis of conducting solids by ICP-MS.** Houk, R.S.; Jiang, S.J. (Ames Lab.-USDOE). pp 79 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

The determination of elemental impurities in metals and alloys has long been an important task for the analytical chemist. The scenarios for such analyses often require the concentration data only a few minutes after sampling so that sample dissolution is not feasible. Arc or spark emission spectrometry has been a workhorse technique for these applications for years. This paper describes the analytical capabilities of a solid sampling system which permits direct analysis of metals by inductively coupled plasma-mass spectrometry (ICP-MS). Additional data for interesting metals and alloys such as brasses, rare earths, and nichrome are presented.

39311 **Spectral characteristics of the atmospheric pressure helium afterglow in the vacuum ultraviolet.** D'Silva, A.P.; Chriswell, C.; Fassel, V.A. (Ames Lab., Iowa State Univ., Ames, IA 50011). pp 93 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

The helium afterflow discharge (HeAD) operating at atmospheric pressure in flowing helium has been shown to be a very sensitive element specific detector for gas chromatography. In this communication the authors report on the spectral characteristics of the HeAD detector in the 60-400 nm region. Analytical data on the performance of the capillary GC-HeAD detection system are discussed.

39312 **Where do we go from here.** Fassel, V.A. (Ames Lab. - DOE). pp 56 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

The search for 'flame-like' plasmas as useful vaporization, atomization, excitation, and ionization cells for analytical atomic spectroscopy has led to the description and the development of a variety of transferred DC plasmas, plasma jets or 'plasmatrons,' capacitively coupled, high frequency induced plasmas, microwave induced capillary plasmas, and inductively coupled plasmas. Judged on the basis of their acceptance by the analytical community, by growth in usage and by the number of instruments sold, the inductively-coupled versions clearly have had the greatest impact.

39313 **Isotopic ratio measurements with ICP-MS.** Russ, G.P.; Bazan, J.M. (Nuclear Chemistry Div., Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 45 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—). Contract W-7405-ENG-48.

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

The precision and accuracy obtainable in isotope ratio measurements by ICP-MS depend on a number of factors including background, dead time, mass fractionation, abundance sensitivity, and counting statistics. Depending on the choice of sample, the ratio being measured, and the mode of mass scanning, any one of these factors or combination of them may limit the quality of the analysis.

39314 **ICP-FTS: A new analytical tool; potentials and problems.** Faires, L.M. (Analytical Chemistry Group, Chemistry Div., Los Alamos National Lab.). pp 206-207 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Inductively coupled plasma - Fourier transform spectrometry is currently being investigated at several different laboratories as a possible new tool for the analytical chemist. Studies in the author's laboratory over the past three years have explored the ICP-FTS combination using the one-meter FTS located at the National Solar Observatory at Kitt Peak, Tucson. It is now possible to begin to define some ideal criteria for the design of a FTS specifically for ICP applications. These criteria are presented.

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REFER ALSO TO CITATION(S) 38457, 38500, 38501, 38529, 38564, 38569, 38687, 38962, 38965, 38966, 39202, 39255, 39302, 39303, 39304, 39306, 39307, 39308, 39309, 39310, 39311, 39346, 39417, 39455, 39587, 39888, 40217

39315 **(BMFT-FB-T—86-138) Standardization of procedures for determining activity and selectivity of catalysts by comparative kinetic investigations in different laboratory reactors. Final report.** Baerns, M.; Hofmann, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bochum Univ. (Germany, F.R.). Technische Chemie; Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Technische Chemie). Dec 1986. 242p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770138.

Standardization of experimental methods for comparative characterization and evaluation of activity and selectivity of solid catalysts has been only achieved in a few instances up to now. The object of the present study was to develop such methods. Industrial catalysts were investigated in various laboratory reactors in two laboratories. Catalysts for CO methanation which was affected by pore diffusion and for the oxidation of butene-1 and butane to maleic anhydride as an example for a reaction network were used. The results of the kinetic catalyst characterization are presented in the form of activity and selectivity diagrams as well as by suitable reaction rate equations. The measures of activity and selectivity as derived hereby are compared with virtual catalyst performance in pilot plant reactors the behavior of which was also simulated by reactor modelling. Significant comparisons of activity and selectivity of different catalysts are only possible if their experimental determination including catalyst pretreatment is carried out according to well defined procedures. If this requirement can be met for different reactors comparable results are obtained. The procedures cannot be generalized but have to be adapted to each specific reaction system. With 37 refs., 50 tabs., 167 figs.

39316 **(BNL—39942) The role of metals in aqueous superoxide chemistry.** Bielski, B.H.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-870701—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012125.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

A focal point in the research of metal catalyzed reactions involving oxygen derived species/radicals (OH, HO_2/O_2^-, H_2O_2, etc.), is the search for the true nature and mode of formation of the oxidizing agent(s) responsible for the biological damage observed in systems containing both hydrogen peroxide and superoxide radicals. There appears to be a general agreement that one of the most deleterious species is the OH radical, generated either in the "Metal Catalyzed Haber Weiss Reaction" or a "Reductant Driven Fenton Type Reaction." The subtle difference between these two mechanisms is that Mechanism I is merely a specific case of a system (Mechanism II) that generates OH radicals using a variety of metals (Fe, Cu, Mn, Ti, etc.) and reductants. 41 refs.

39317 **(DEMO—85/9) Comparison of leaching tests and study of leaching mechanisms.** Amarantos, S.G.; Papadokostaki, K.G.; Petropoulos, J.H. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Oct 1985. 37p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702437.

The present work is concerned first with the study of certain aspects of the leaching kinetics of Cs^+ and Sr^{++} embedded in cement, as Cs_2SO_4 and $SrSO_4$, and in particular: (a) the comparative evaluation of leaching in (i) stagnant, (ii) stirred and (iii) continuously flowing (modified Soxhlet) water, (b) the effect of atmospheric CO_2 on elution, (c) the effect of temperature changes during leaching. Secondly, model kinetic studies were carried out using cellulose acetate incorporating $SrSO_4$, $CaSO_4$ or NaCl. The main results obtained were: (1) Cs leaching rates were not significantly affected by the leaching method or by the presence of atmospheric CO_2. The embedded Cs exists in relatively easily leachable and less rapidly leachable (most probably located within the gel regions) forms. (2) Elution of Sr is retarded by stagnant and infrequently renewed leachant (method (i)) and by the presence of atmospheric CO_2; leaching method (iii), which tends to minimize both of these effects, gave the highest elution rates. (3) The observed elution kinetics in the case of cellulose acetate-$CaSO_4$ or $SrSO_4$ conform to the Higuchi model, but a more elaborate theory is needed for the cellulose acetate-NaCl system.

39318 **(GKSS—86/E/59) PRMIXn - a computer code for determination of properties of state and transport of real gases and their mixtures.** Fulfs, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1986. 77p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08661.

Siemens 7875.

This report describes the code PRMIXn for determination of properties of state and transport (in SI-units) of real gases (all elementary gases as well as several technically important gaseous compounds) and their mixtures in the gaseous state as function of pressure (1-200 bar) and temperature (200-2000 K). All the used algorithms from the literature and their modifications will be documented. For a variety of pure gases and mixtures each property is compared to corresponding values from the literature; the agreement is mainly good or even very good. PRMIXn is a single precision FUNCTION written in FORTRAN 77.

39319 **(NIPER—247) Thermodynamic studies related to the hydrogenation of phenanthrene: Topical report.** Chirico, R.D.; Hossenlopp, I.A.; Nguyen, A.; Strube, M.M.; Steele, W.V. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jul 1987. Contract FC22-83FE60149. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE87001252.

Experimental details of vapor pressure, enthalpy of combustion, and condensed-phase heat-capacity studies are reported for 2-ethylbiphenyl, 2,2'-dimethylbiphenyl, and 1,2,3,4-tetrahydrophenanthene. The results are combined to produce values of the Gibbs energy of formation in the ideal-gas state at selected temperatures for each molecule. Revised ideal-gas state properties, based on new experimental information, are tabulated for phenanthrene and 9,10-dihydrophenanthrene. Results are used in equilibria calculations for abbreviated phenanthrene/hydrogen reaction networks. Reaction networks with and without ring opening are considered. Several generalizations are drawn concerning reaction conditions necessary to produce specific products. Calculated equilibrium concentrations for non-ring-opened species are compared with experimental values from the literature derived by batch reaction and detailed analyses. Finally, several related kinetic and coal-liquefaction studies, which illustrate the importance of both thermodynamic and kinetic (i.e., catalytic) considerations in reaction path determination, are discussed. Estimates, based on group-additivity methods, for the ideal-gas state properties for a series of dialkylnaphthalenes are provided in an appendix. 56 refs., 15 figs., 22 tabs.

39320 (UCRL—96525) Phase changes and chemistry at high pressures and temperatures. Ree, F.H. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 7p. (CONF-870753—34). NTIS, PC A02. File Number DE87012625.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Some of the interesting changes that occur in nature involve phase changes and chemical reactions at high pressures and temperatures. This paper gives new equilibrium and nonequilibrium calculations on reactive mixtures and a review on recent theoretical works in this field.

39321 Inelastic neutron scattering study of the torsional and CCC bend frequencies in the solid n-alkanes, ethane—hexane. Nelligan, W.B.; LePoire, D.J.; Brun, T.O.; Kleb, R. (Schlumberger-Doll Research, Ridgefield, Connecticut 06877-4108). *Journal of Chemical Physics;* **87**: No. 5, 2447-2456(1 Sep 1987).

High resolution inelastic neutron scattering (INS) spectra of the n-alkanes (n = 2 to 6) have been measured, using the crystal analyzer spectrometer at the intense pulsed neutron source, Argonne National Laboratory, for energy transfer less than 1000 cm^{-1}. In this paper we present these data and extend the valence force field for n-alkanes of Schachtschneider and Snyder by modifying the torsion potential and the C—C—C bending force constants. The modified force constant set provides a much improved match of the frequencies obtained from normal modes calculations to our experimental data in the energy region below 1000 cm^{-1} and a minimal perturbation of the frequencies at higher energies. The amplitude of the scattering peaks measured by the crystal analyzer spectrometer is shown to be closely related to the hydrogen density of states. The data also show peaks produced by lattice mode excitations. These data are not analyzed but are compared with data from the literature.

39322 Applications of filtering theory for the inversion of temporal chemical systems. Beumee, J.G.B.; Rabitz, H. (Program in Applied Mathematics, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics;* **87**: No. 5, 2617-2629(1 Sep 1987).

This paper presents a method for inverting temporal experimental data from chemical models to obtain estimates of unknown parameters. Most of the models under consideration are deterministic and we assume that the measurements obtained from experimental observations are represented as the solution of a differential equation containing the variables of the model. To incorporate any extraneous laboratory effects that are not included in the model, we assume that these equations are perturbed by a white noise process so that the measurements become time-dependent stochastic variables. A particular measurement is then equivalent to a realization of these variables and applying stochastic estimation theory this realization can be used to obtain estimates of the unknown parameters in the model. As an example of this estimation method, we consider chemical kinetics models with various observational equations and construct an estimator for the unknown reaction rate constants. We also show the estimators for the structural constants in a laser model depending on the representation of the experimental data. In some cases the observations are simulated numerically and we present the parameter estimates as a function of time. The efficiency of the estimation process is calculated as the ratio of the a posteriori variance of the parameter estimator and the Rao—Cramer lower bound. Some issues in the numerical implementation of the filtering equations are discussed and a comparison is made between the minimum least-square estimation method and the filtering method.

39323 Nonequilibrium percolative c(2 x 2) ordering: Oxygen on Pd(100). Evans, J.W. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames Iowa 50011). *Journal of Chemical Physics;* **87**: No. 5, 3038-3048(1 Sep 1987). Contract W-7405-ENG-82.

Dissociative adsorption of oxygen on certain (100) metal surfaces has been modeled as random dimer adsorption onto diagonally adjacent empty sites of a square lattice subject to the additional constraint that all six neighboring sites must be empty (the 8-site model). Here we adapt this model to analyze the nonequilibrium c(2 x 2) ordering recently observed for oxygen on Pd(100) at coverages up to saturation (>1/4 monolayer), under conditions of low temperature and high pressure where effects of diffusive mobility can be ignored. We do, however, propose that adsorption could be followed immediately by short range transient mobility to dissipate excess energy. We first show how exact master equations for this model can be used to obtain analytic expressions for various local quantities of interest: the probability of an empty 8-site configuration (which determines the sticking coefficient), the c(2 x 2) island edge or domain boundary densities, etc. They also provide a characterization of, e.g., the asymptotic decay of spatial correlations. Near-percolating (percolative) c(2 x 2) ordering is readily observed in computer simulations of the saturation state. Through a simple extension of the physical model, we provide a framework for analysis of the large scale characteristics of this ordering via correlated polychromatic percolation theory. Corresponding scaling relations and some real space renormalization group analysis are described.

39324 Ab initio study of O, O_2, and C_2H_4 interactions with Ag_2 and Ag^+_2. A model for surface—adsorbate interactions. McKee, M.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and Department of Chemistry, Auburn University, Auburn, Alabama 36849). *Journal of Chemical Physics;* **87**: No. 5, 3143-3152(1 Sep 1987).

Ab initio calculations of silver metal—adsorbate interactions were carried out by using a 36-electron relativistic effective core potential (RECP) for the core electrons of Ag and a 3s3p4d→2s2p2d basis for the valence electrons. Unpromoted surface interactions were modeled by a silver dimer while promoted interactions were modeled by a silver dimer cation. Molecular oxygen is predicted to bind as a π complex while the di-σ and π complexes are predicted to bind similarly for ethylene. The binding energy of O_2 decreases on a promoted surface while the binding energy of C_2H_4 increases compared to an unpromoted surface. The dissociative adsorption of O_2 on a promoted surface is found to be inhibited by the formation of a high energy intermediate. The binding energy of O on a silver surface is well reproduced when corrections are made for the electron affinity of the adsorbate and the ionization energy of the dimer.

39325 A simple method for the synthesis of perdeuterated aromatic hydrocarbons and heterocyclic compounds. Hawthorne, S.B.; Miller, D.J.; Aulich, T.R.; Farnum, S.A. (Univ. of North Dakota Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 471-477(Apr 1987). (CONF-870410—). Contract FG22-86PC90911.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A general method has been developed for the preparation of deuterated aromatic compounds that are useful for coal reaction studies and as internal standards for GC/MS analysis. The method requires little specialized equipment or synthesis expertise. A reaction mixture containing Cl, D/sub 2/O, and chromium is used to exchange deuterium for aromatic hydrogens at temperatures of 200° to 300°C. A single set of reaction conditions can be used to prepare a wide range of deuterated aromatics with nearly complete exchange of aromatic hydrogen for deuterium and little or no chemical degradation of the reactant. When a 20:1 molar ratio of deuterium to aromatic hydrogen was used the isotopic purity of most species tested.

39326 Simultaneous acquisition of pure rotational and vibrational nitrogen spectra using three-laser CARS. Lucht, R.P.; Maris, M.A. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). pp MB2.1-MB2.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The author used three-laser coherent anti-Stokes Raman scattering to acquire simultaneously the pure rotational and vibrational spectra from the nitrogen molecule. The energy level schematic for the three-laser CARS process is shown in this paper. Frequency-doubled Nd:YAG laser radiation at frequency ω/sub 1/ is used to pump a broadband dye laser which lasers at a range of frequencies ω/sub s/ and a narrowband dye laser with frequency ω/sub 2/. The three-beams are focused to a common CARS probe volume using a three-dimensional phase-matching geometry. A CARS polarization is established when the frequency difference ω/sub 1/ - ω/sub s/ corresponds to a vibrational Raman resonance. The vibrational polarization scatters the incident ω/sub 2/ beam to produce anti-Stokes radiation at frequency ω/sub 1/ - ω/sub s/ + ω/sub 2/. In a similar fashion, a CARS polarization is also established when the frequency difference ω/sub 2/ - ω/sub s/ is equal to a pure rotational Raman resonance. The pure rotational polarization scatters the Nd:YAG laser radiation at ω/sub 1/ to produce anti-Stokes radiation at ω/sub 2/ - ω/sub s/ + ω/sub 1/.

39327 **Doppler-free resonance ionization mass spectrometry of beryllium.** Travis, J.C.; Lucatorto, T.B.; Wen, J.; Fassett, J.D.; Clark, C.W. (U.S. National Bureau of Standards, Gaithersburg, MD 20899). pp TuB2.1-TuB2.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The two-photon resonance ionization scheme employed for beryllium requires two —280-nm photons to excite the 2s6s (/sup I/S/sub 0/) state from the 2s/sup 2/ (/sup I/S/sub 0/) ground state. Ionization is then achieved from the excited state by means of a 1064-nm infrared photon from the Nd:YAG pump laser. First-order cancellation of the Doppler broadening of the two-photon transition is achieved when the two photons are separately derived from counter-propagating beams of the same wavelength. The "Doppler-free" line profile obtained in a spectral scan is normally super-imposed on a "Doppler pedestal" resulting from the abosrption of both photons from the same one of the two counter-propagating beams. To achieve the desired isotopic selectivity, it is necessary to eliminate, or greatly reduce, the Doppler pedestal. This can be done by circularly polarizing the counter-propagating beams in such a fashion that absorption of one photon from each beam would impart an allowed Δm=0 change in a /sup 1/S/sub 0/ - /sup 1/S/sub 0/ transition, while two photons from either beam would impart a forbidden change of Δm=+-2. The RIMS (Resonance Ionization Mass Spectrometry) spectrometer employed here has been described previously except for the substitution of a narrow-band pulsed dye amplifier (PDA) for the pulsed dye laser. The three-stage PDS amplifies the emission of a single-mode cw dye laser, yielding a measured bandwidth of 170 MHz at 560 nm. 20-mJ pulses from the PDA are frequency-doubled to yield —2 mJ pulses in the UV. Use of a long (—90-cm) collimating lens at the PDA output, prior to doubling, results in a nearly-collimated UV beam of about 2-mm diameter at the sample site.

39328 **Elemental analysis of corrosion resistant glasses using ICP.** Weissman, S.H. (Sandia National Labs., Analytical Chemistry Div., Albuquerque, NM 87185). pp 158-159 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—). Contract AC04-76DP00789.

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Sandia National Laboraties is involved in developing several corrosion resistant glasses for a variety of engineering applications. Determining the elemental composition of each glass is an important part of the development and production process. TA-23 is a corrosion resistant glass developed for glass-to-metal seals in a long life lithium/sulfur dioxide battery. Techniques developed for the analysis of TA-23 using different digestion methods will be reported and compared, with emphasis on digestions using the microwave oven and pressurized vessels. Data will be reported on the effect of microwave power, digestion time, sample size and acid concentration on glass dissolution rates. In addition, the ICP system used will be described.

39329 **Excited state populations and new values for oscillator strengths by ICP-FTS.** Brault, J.W.; Faires, L.M. (National Solar Observatory, P.O. Box 26732, Tucson, AZ 85726). pp 211 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—).

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

High resolution Fourier transform spectrometry is a powerful information gathering tool. Comprehensive wavelength coverage combined with high accuracy of both wave numbers and relative intensities make the FTS extremely useful in spectrochemical studies of sources such as the inductively coupled plasma. Conversely, the ICP shows great promise as a source of medium precision (<25%) transitions probabilities. These transition probabilities will be especially useful in the infrared, where very few published measures exist (the latest critical compilation from NBS for the allowed lines of Fe, Co, and Ni in all stages of ionization, for examples, shows no lines above 8000A).

39330 **Barium carbonate catalysis of carbon gasification.** Ersolmaz, C.; Falconer, J.L. New York, NY; American Institute of Chemical Engineers (1985). 22p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

The interaction of barium carbonate with carbon black was studied to understand catalyzed CO/sub 2/ gasification of carbon. Temperature-programmed reaction with isotopic labeling of the carbonate and the carbon showed that carbon dramatically accelerated with rate of BaCO/sub 3/ decomposition to form BaO and CO/sub 2/, which rapidly gasified carbon to form CO. Pure BaCO/sub 3/ was observed to exchange carbon dioxide with the gas-phase, and the exchange rate was significantly increased by carbon at higher temperatures, due to formation of a carbon-carbonate complex. The interaction of BaCO/sub 3/ and C to form a complex occurred well below gasification temperatures, and BaCO/sub 3/ did not decompose until after gasification began and the gas phase CO/sub 2/ concentration was low.

39331 **Non-Equilibrium Brownian Dynamics simulation of macromolecules in steady shear flow.** Dotson, P.J.; Saab, H.H. New York, NY; American Institute of Chemical Engineers (1985). 30p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 26F.

A Non-Equilibrium Brownian Dynamics (NEBD) simulation method is described, along with the basic equations necessary for its implementation in a steady shear flow. Several NEBD simulations are described in which the Rouse chain is used as the model for a macromolecule. Results for the mean end-to-end distance, the distribution of included angles, and the pair distribution function are offered to demonstrate the utility of the method. The simulation results are compared to analytical results, including several newly derived, and the agreement is within 5%.

39332 **Effects of support on carbon formation and gasification on nickel during CO hydrogenation.** Bartholomew, C.H.; Strasburg, M.V. New York, NY; American Institute of Chemical Engineers (1985). 25p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 12E.

Rates of carbon deposition during CO hydrogenation at 325-450°C and of carbon removal by O/sub 2/ at 300-350°C on Ni/Al/sub 2/O/sub 3/, Ni/SiO/sub 2/, and Ni/TiO/sub 2/ were determined by in situ gravimetric measurements. Following an induction period, carbon deposits on these catalysts at very significant rates; the order of decreasing deposition rate is Ni/TiO/sub 2/, Ni/Al/sub 2/O/sub 3/, Ni/SiO/sub 2/. Rates of gasification of these deposits in O/sub 2/ decrease in the same order. The order of de-

creasing deposition rate is the same as for CO dissociation and removal of carbidic carbon by reaction with hydrogen.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 38470, 38476, 39201, 39221

4005 Photochemistry

REFER ALSO TO CITATION(S) 39580

39333 **Ozone visible photodissociation dynamics.** Levene, H.B.; Nieh, J.; Valentini, J.J. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics;* **87**: No. 5, 2583-2593(1 Sep 1987).

The photolysis of ozone at 300 K in the Chappuis band has been investigated through collision-free coherent anti-Stokes Raman scattering (CARS) spectroscopy of the molecular oxygen photofragment. We have obtained the nascent electronic, vibrational, rotational, and translationai energy distributions for nine photolysis wavelengths over the range 560—638 nm. The O_2 photofragments are always formed in the ground ($^3\Sigma^-$/sub g/) state, there is no evidence for production of the excited ($^1\Delta$/sub g/) state. Only a narrow range of high rotational levels are populated. The rotational distribution shifts to higher rotational states as the available energy increases. The vibrational distribution, however, is independent of photolysis wavelength. Only states v = 0 to v = 4 are populated, and there is a population inversion between v = 2 and v = 3. The average partitioning of energy among the vibrational, rotational, and translational degrees of freedom is 10%, 24%, and 66%, respectively. These results are interpreted to imply vibrationally adiabatic but rotationally impulsive dissociation dynamics. The O_2 photofragment vibrational distribution is explained by Franck—Condon vibrational overlaps between O_2 and the ground $^1A_1$ electronic state of O_3. Detailed consideration of the angular momentum disposal in the photodissociation indicates a strong correlation between the direction of the O_2 angular momentum produced by the dissociative energy release, and the direction of the angular momentum of the O_3 in-plane rotation. The correlation is such that of two energy degenerate final states, the one of higher orbital angular momentum is not produced.

39334 **Photochemical preparation of plutonium pentafluoride.** Rabideau, S.W.; Campbell, G.M. (to Dept. of Energy, Washington, DC). US Patent 4,670,239. 2 Jun 1987. Filed date 20 Dec 1977. vp.

A method is described of preparing PuF/sub 5/ which comprises irradiating PuF/sub 6/ with radiation having a wavelength less than 520 nm and an intensity sufficient to photodissociate the PuF/sub 6/ to PuF/sub 5/.

4006 Radiation Chemistry

39335 **(AD-A—179795/0/XAB) Preparation, characterization, and utilization of electrodes coated with polymeric networks formed by gamma-radiation crosslinking. Final report, 1 August 1982-31 January 1987.** Heineman, W.R.; Mark, J.E. (Cincinnati Univ., OH (USA)). 1 Apr 1987. 37p. NTIS, PC A03/MF A01.

The preparation, characterization, and application of electrodes with specific chemical properties that are imparted by surface modification with polymer networks are the long-range goals of this research. Networks that are formed by crosslinking with gamma radiation were evaluated with respect to swelling in aqueous solution, retention of polymer in the network, permeability, and the effect of radiation dosage on all of these properties through its control of crosslinking. Ionic water-soluble polymers such as polydiallyl dimethyl ammonium cholride, poly vinylbenzyl trimethyl ammonium chloride, ploystyrene sulfonic acid, sodium salt and polyacrylic acid, which would ordinarily dissolve from the electrode surface in aqueous solution unless crosslinked into a network, and several neutral polymers such as polyacrylonitrile, polyethyleneimine, polydimethylsiloxane and poly vinyl alcohol investigated. The covalent attachment of organic and inorganic redox mediators and enzymes to networks by gamma irradiation of a mixture of polymer and the agent have been investigated. Network-coated electrodes with the appropriate properties are being developed for specific applications that required a stable, easily fabricated, fouling-resistant, rapidly responding, sensitive, and selective electrode.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 38572, 38675, 39290, 39669

39336 **(AAEC/E—636) Preparation of ^{32}P labelled phosphorous acid.** Henderson, D.; Jenkinson, A.; Sorby, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702418.

Phosphorous acid labelled with ^{32}P has been prepared, on a small scale, starting from neutron-irradiated phosphorus. The compound is intended for tracer studies in the development of novel fungicides.

39337 (INIS-BR—651, pp 13) **Chromatographic control of radiopharmaceuticals.** Lima, J.E.T.; Barros, D.S.; Marinho, J.C.A.; Maliska, C. (Hospital Central do Exercito, Rio de Janeiro, Brazil. Servico de Medicina Nuclear). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39338 **(ISH—94) Quality control of in vivo radiopharmaceuticals. A manual for use in nuclear medical laboratory on analysis of radiochemical impurities.** Hammermaier, A.; Reich, E.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jun 1986. 227p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-08603.

This manual for use in the nuclear medical laboratory is dealing with the quality control of in vivo radiopharmaceuticals while considering the theoretical background of various influencial parameters. Practical and theoretical guidelines are given for quality control tests, as well as possible technical error sources that may result in chromatography related artefacts. The emphasis of this manual lies in a compilation of methods used to analyse the radiochemical impurity of in vivo radiopharmaceuticals. The content of the manual is divided into 6 parts. Part 1 refers to general quality control aspects. Part 2 provides an overview of quality control principles and methods. Part 3 contains the most commonly in vivo radiopharmaceuticals used in tabular form, along with their area of use and current producers/distributors in the Federal Republic of Germany (status December 1985). A compilation of essential analytical methods for investigating radiochemical impurities of in vivo radiopharmaceuticals in nuclear medical routine use is contained in part 4 of the manual. Part 5 describes the most important technical error possibilities in radiochemical quality control. The list of references (Part 6) contains review studies of quality control as well as original reports of all of the analytical methods listed.

39339 **Synthesis of non-steroidal estrogen receptor binding compounds labeled with sup(80m)Br.** Seevers, R.H.; Mease, R.C.; Friedman, A.M.; Desombre, E.R. (Michael Reese Hospital, Chicago, IL, USA; Argonne National Lab., IL, USA; Chicago Univ., IL, USA. Dept. of Radiology; Chicago Univ., IL, US. Ben May Lab. for Cancer Research). *Nuclear Medicine and Biology;* **13**: No. 4, 483-495(1986). (CONF-8504307—). Contract W-31-109-ENG-38.

From Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides; Miami Beach, FL, USA (29 Apr 1985).

Estrogen receptor (ER) binding radiopharmaceuticals have potential for use in the diagnosis and treatment of cancers of the female reproductive system. Two triphenylethylene derivatives based on the structure of hydroxytamoxifen 4, a high ER binding metabolite of tamoxifen 5, have been prepared: 1-(4-

dimethylaminoethoxy)phenyl]-1-(4-hydroxy)phenyl-2-bromo-2-phenylethylene 2 and 1,1-bis(p-hydroxyphenyl)-2-bromo-2-phenylethylene 3. Both 2 and 3 bind strongly to the ER. Compound 3 has been labeled in modest yield by direct bromination with sup(80m)Br, which was produced by the ^{83}K (d,nα) reaction. Radiolabeled 22, a dimethoxy precursor of 3, has been prepared in yields ranging between 40 and 60% by a bromination destannylation reaction.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 39130, 39288, 39541

39340 (AGARD-CP—99, pp vp) **Application of CARS thermometry to a turbulent flame.** Magre, P.; Moreau, P.; Collin, G.; Pealat, M. Nov 1986. (In several languages). NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The good spatial and temporal resolution of broad-band Coherent Anti-Stokes Raman Spectroscopy (CARS) diagnostic is suitable for turbulent flows and allows instantaneous temperature measurements in the reaction zone. From these instantaneous values, temperature probability density functions (PDF) are built. CARS thermometry is applied to a high velocity premixed flame. The combustion of an air-methane flow (u approx. equal to 55 m/s, T approx. equal to 560 K, equivalence ratio = 0,8) in the combustor is ignited and stabilized by a parallel flow of hot gases (u approx. equal to 110 m/s, T approx. equal to 2000 K). The mixing of the two flows without combustion (equivalence ratio = 0) is also studied as well as combustion stabilized by a step replacing the hot gases.

39341 (AGARD-CP—99, pp vp) **Study of combustion by means of diode laser spectroscopy.** Rosier, B.; Gicquel, P.; Henry, D. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The experimental apparatus and results with a diode laser spectrometer used to obtain absorption signatures of premixed methane-air burning in a furnace are reported. A tunable laser was used to scan the reaction zone with an acuity of 1900 lines/cm. Absorption data collected from the furnace were compared with reference spectra of known gases. Pulse frequencies of 50 Hz to 1 kHz were explored. The data obtained were useful for characterizing the temperatures and composition of the burning gases, identifying the presence of cold layers, and quantifying the mass concentrations of various gases along the flame front.

39342 **(DOE/ER/13269—T2) An unsolicited proposal to study CH reactions relevant to combustion/gasification processes: Final report, July 1985-July 1986.** Anderson, S.M.; Freedman, A.; Kolb, C.E. (Aerodyne Research, Inc., Billerica, MA (USA). Center for Chemical and Environmental Physics). Dec 1986. Contract FG02-84ER13269. 17p. (ARI-RR—572). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012081.

Reactions studied were of CH radicals with Cl_2, CH_4, N_2O, O_2, and H_2 at 290°K. Rate constants were determined. (DLC)

39343 **(LBL—23463) Flame induced vorticity: Effects of stretch.** Pindera, M.Z.; Talbot, L. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 36p. (CONF-860804—14). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010983.

From 21. international symposium on combustion; Munich, F.R. Germany (3 Aug 1986).

In many combustion situations, the flame may be regarded as an interface separating fluids of different densities: fresh reactants from burnt products. Basic considerations of such thin flames indicate that in general the velocity field in the burnt regions is rotational; that is, flames produce vorticity. The circulation of the above flow depends linearly on the flame stretch. In order to account for the jump in normal velocity across the flamefront, the flame may be thought to consist of a collection of sources whose strength depends on the density ratio and the laminar flame speed. For flames of finite length it is shown that the cumulative action of these sources induces an additional contribution to the stretch, and thus to the circulation. These sense of rotation of this flame-induced circulation is such as to decrease the flame-induced stretch. The effects of vorticity production on the velocity field is illustrated for the case of the stretch caused by the presence of the flame only, and for the stretch dominated by cold flow inhomogeneities, in steady flow conditions. The results indicate that for flames of finite extent, the production of vorticity forms an integral part of the overall velocity field and that ignoring the effects of fluid rotation may lead to results not in accordance with experiment.

39344 (N—87-20267, pp vp) **Chemical shock tube as a tool for studying high-temperature chemical kinetics.** Brabbs, T.A. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

Although the combustion of hydrocarbons is our primary source of energy today, the chemical reactions, or pathway, by which even the simplest hydro-carbon reacts with atmospheric oxygen to form CO_2 and water may not always be known. Furthermore, even when the reaction pathway is known, the reaction rates are always under discussion. The shock tube has been an important and unique tool for building a data base of reaction rates important in the combustion of hydrocarbon fuels. The ability of a shock wave to bring the gas sample to reaction conditions rapidly and homogeneously makes shock-tube studies of reaction kinetics extremely attractive. In addition to the control and uniformity of reaction conditions achieved with shock-wave methods, shock compression can produce gas temperatures far in excess of those in conventional reactors. Argon can be heated to well over 10 000 K, and temperatures around 5000 K are easily obtained with conventional shock-tube techniques. Experiments have proven the validity of shock-wave theory; thus, reaction temperatures and pressures can be calculated from a measurement of the incident shock velocity. A description is given of the chemical shock tube and auxiliary equipment and of two examples of kinetic experiments conducted in a shock tube.

39345 **(SAND—86-0790) Numerical simulation of buoyant convection in vented enclosures.** Schutt, J.A.; Baer, M.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011574.

The buoyant convection in a two-dimensional enclosure with openings is solved using a primitive variable explicit finite difference technique. A non-Boussinesq acoustically-filtered formulation is used which models inviscid buoyantly driven flows in a stratified environment. The numerical algorithm uses the flux-corrected transport (FCT) technique to resolve energy and vorticity fields, and the pressure field is determined using a direct method for solving nonseparable elliptic equations. The numerical algorithm requires that pressure and kinetic energy be combined into a "total" pressure field. A novel method is presented for treating inflow/outflow boundaries, where the direction of flow across the boundary is not known a priori. Demonstrative calculations are shown which simulate a fire environment in a vented room of planar geometry. The fire source is idealized as a distributed energy source. The calculations show the effect of venting on entrainment and induced flow.

39346 **Photochemical effects in two-photon-excited fluorescence detection of atomic oxygen in flames.** Goldsmith, J.E.M. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). pp MB4.1-MB4.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

Much of the recent attention on developing techniques for measuring radical concentrations in flames, and atoms in particular,

has focused on the use of multiphoton excitation schemes. One of the early papers on atomic oxygen detection in flames reported photochemical production of oxygen atoms in room air, drawing attention to the need for caution to make sure that these optical techniques are in fact as nonintrusive as they are claimed to be. The author demonstrated recently that photochemical effects can have a strong influence in 205-nm, two-photon-excited fluorescence detection of atomic hydrogen in atmospheric-pressure flames. In this paper the author reports similar effects in measuring atomic oxygen concentration in flames, and demonstrate that excess atomic oxygen concentrations can be produced by single-photon excitation of the Schumann-Runge bands of vibrationally excited oxygen molecules present in the flame. Most of efforts in this study were directed towards studying a lean (equivalence ratio 0.8), atmospheric-pressure hydrogen-oxygen flame that has been used for making other measurements of flame radicals.

39347 **Thermal ignition and minimum ignition energy in oxygen-ozone mixtures.** Raffel, B.; Warnatz, J.; Wolff, H.; Wolfrum, J.; Kee, R.J. pp 335-346 of Dynamics of reactive systems; International Colloquium on Dynamics of Explosions and Reactive Systems, 10th, Berkeley, CA, Aug. 4-9, 1985, Technical Papers. Part 2 - Modeling and heterogeneous combustion. Volume 105. Bowen, J.R.; Leyer, J.C.; Soloukhin, R.I. New York, NY; American Institute of Aeronautics and Astronautics, Inc. (1986). (CONF-850830—).

From 10. international colloquium on dynamics of explosions and reactive systems; Berkeley, CA, USA (4 Aug 1985).

To study the influence of chemistry on the ignition process, thermal ignition in a one-dimensional configuration is studied experimentally and by computer simulation for O_2-O_3 mixtures. For this purpose, the decomposition of O_2-O_3 mixtures is studied experimentally by laser-induced ignition in the axis of a cylindrical combustion chamber. To interpret these measurements, the corresponding time-dependent, one-dimensional conservation equations (assuming uniform pressure) are integrated by various differential/algebraic solvers. Experimental results on thermal minimum ignition energies in O_2-O_3 mixtures can be simulated by the calculations within the limits of experimental error. On the basis of this calibration, further simulations are carried out to study the dependence of minimum ignition energy on ignition source diameter and ignition time to get more information on the nature of the ignition process. 12 references.

42 ENGINEERING

REFER ALSO TO CITATION(S) 39148

39348 **(CONF-8706117—1) The weight of mass or the mess of weight.** Gat, U. (Oak Ridge National Lab., TN (USA)). 24 Jun 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009827.

From Symposium on standardization of terminology: theory and practice; Cincinnati, OH, USA (24 Jun 1987).

This paper explores the cause of confusion associated with the words mass and weight, and offers suggestions to correct the problem. It is recommended that in technical and scientific use, weight shall be restricted to mean force of gravity. Technical standards, ASTM and others, and terminology shall clearly reflect and define weight to be force of gravity. Weight should be avoided in technical context because of its imprecision. Legal, formal, and official language shall use weight to mean force only. Under no circumstances should the SI units of mass, the kilogram, or its derivatives, be associated with weight. The term weight should be avoided in any language and wording that intends to convey a precise or important meaning. ASTM should revise all standards and terminology accordingly.

39349 **(LA-UR—87-2221) Techniques for gas gun studies of shock wave attenuation in snow.** Brown, J.A.; Gaffney, E.S.; Blaisdell, G.L.; Johnson, J.B. (Los Alamos National Lab., NM (USA); Ktech Corp., Albuquerque, NM (USA); Army Cold Regions Research and Engineering Lab., Hanover, NH (USA); Army Cold Regions Research and Engineering Lab., Fort Wainwright, AK (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011731.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Shock compression of snow is of interest for its direct applications to such fields as planetary science and arctic and military engineering. A technique has been adopted using stress gauges embedded in gas gun targets of natural snow. The program was begun with efforts to identify and solve major experimental difficulties. These difficulties and their solutions are described and data records obtained from preliminary tests are discussed. 8 refs., 3 figs.

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REFER ALSO TO CITATION(S) 38593, 38596, 38599, 38668, 38703, 38866, 38867, 38873, 38914, 38915, 38977, 39153, 39205, 39435, 39443, 39444, 39493, 39496, 39521, 40230, 40287

39350 **(BNL—39817) Correlation between the performance and metrology of glancing-incidence synchrotron-radiation mirrors containing millimeter-wavelength shape errors.** Takacs, P.Z.; Hewitt, R.C.; Church, E.L. (Brookhaven National Lab., Upton, NY (USA); Exxon Research and Engineering Co., Annandale, NJ (USA); Picatinny Arsenal, Dover, NJ (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870132—10). NTIS, PC A02. File Number DE87010758.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

This paper concerns the properties of a set of ellipsoidal x-ray mirrors manufactured for use at the National Synchrotron Light Source at Brookhaven. The objective is to compare the results of functional tests made at x-ray wavelengths and at glancing incidence with predictions based on laboratory measurements of their surface shapes made with a Wyko profiling microscope. The functional tests of the fully-illuminated mirrors indicated unacceptable image widths of roughly 300 μrad. The washout of the subimage fine structure in the case of the fully-illuminated mirrors is attributed to the presence of longer-wavelength surface errors than are included within the bandwidth of the Wyko measurements. The present analysis is unusual in that it involves the prediction of the effects of shape errors with amplitudes which lie between the smooth-surface limit, where the intensity in the image plane is a mapping of the power spectral density of the error, and the rough-surface limit, where it is a mapping of its slope distribution function.

39351 **(BNL—52067) Cable insulation development (1): Superconducting power transmission system development (2): Annual report for the period 1 October 1985-30 September 1986.** (Brookhaven National Lab., Upton, NY (USA)). 9 Feb 1987. Contract AC02-76CH00016. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012306.

Progress is reported for two projects, the development of a superconducting power transmission system and an ambient temperature high stress power cable. The objective of the superconducting power transmission cable program is to develop a system which is economical and technically attractive to the utility industry. Laboratory work in this project has extended to an outside test facility which represents an intermediate step between the laboratory scale and a full-scale system. Ambient temperature high stress cable development has involved development of a fully synthetic polyethylene or polypropylene dielectric tape for use as electrical insulation. 12 figs., 5 tabs.

39352 (CONF-8706130—1) Neural network representation of sensor graphs in autonomous robot path planning. Jorgensen, C.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011125.

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

This paper discusses a continuous valued associative neural network used for anticipatory robot navigation planning in partially learned environments. A navigation methodology is implemented in four steps. First, a room is represented as a lattice of connected voxels formed by dividing navigation space into equal sized volumetric cells. Each voxel is associated with a simulated neuron. The magnitude of a neurons activation corresponds to a probability of voxel occupancy calculated from a series of sonar readings taken by an autonomous robot. Neurons are trained with a series of room patterns derived from varying robot sensor perspectives. At another time, the robot is exposed to a single perspective of one of the rooms and utilizes the sensor return as a cue to prompt associative recall of a best guess of the complete interior of the room. A two step path planning operation is then invoked which uses line of sight readings and anticipated global information to form a trial path plan. The planning process merges a nearest neighbor grid cell technique and a simulated annealing gradient descent method to optimize traversal movements. In the final step, the path is followed until a mismatch between the estimated room and the actual sensor returns indicate incorrect anticipation. Implementation of the method on a Hypercube computer is discussed along with memory computation tradeoff requirements.

39353 (DFVLR-FB—86-63) Comparison of different kinds of compact crossflow heat exchangers. Siemens, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 12 Dec 1986. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770166.

A program for computation of compact crossflow heat exchangers was developed. The most important coefficients, pressure drops, and effectiveness are used to compare the different kinds of exchangers. For this, the Mach number, the ratio of the sides of the exchanger, and the compactness are varied. With 43 figs., 4 tabs.

39354 (DOE/ER/13315—2) Method of vibrational control in the problem of stabilization of chemical reactors: Final report for period January 1, 1985-April 30, 1987. Meerkov, S.M. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). May 1987. Contract FG02-85ER13315. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011014.

The main objective of this research project was to complete the development of a new control technique, referred to as Vibrational Control, and apply it to stabilization of chemical reactors. This objective has been achieved and the following results have been obtained: the theory of vibrational stabilizability and vibrational controllability for nonlinear systems has been developed; a new technique for asymptotic analysis of stochastic dynamical systems has been derived; a vibrational control approach to linear and nonlinear distributed parameter systems has been suggested; the methods obtained have been applied to exothermic CSTR's; and the foundations of vibrational feedback control theory have been developed and it was shown that vibrational feedback control offers additional capabilities in comparison with time invariant controllers.

39355 (HEDL-SA—3410) Incorporation of safety interlocks in commercial robotics for handling of nuclear materials. Moore, F.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 30 Apr 1986. Contract AC06-76FF02170. 8p. (CONF-8609242—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010729.

From Robots west conference; Long Beach, CA, USA (22 Sep 1986).

The adaptation of commercial robotic systems to applications in the manufacturing of nuclear fuel has required the addition of safety interlocks as to the handling and accountability of nuclear materials. Also, additional safety interlocks are required when the robots are operated in containment enclosures that are environmentally sealed. Interlocks have been incorporated in a commercial robot which was modified and with additional interlocks into the existing robotic control system. The robotic system has been installed in the containment enclosure as part of the pellet storage subsystem in the Secure Automated Fabrication facility currently being built by Westinghouse Hanford Company for the US Department of Energy. The system has been installed in the Fuel Cycle Plant and is scheduled for initial operational testing in 1986.

39356 (IKE—7-5) Air coolers and heat recovery systems - investigation to minimize the effort in testing procedures. Grammling, F.J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). May 1985. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770199.

The height of a finned air cooler has no quantifiable influence on the cooling performance and the pressure drop when condensation occurs on the air side. This was found by both the measured relations between enthalphy related overall heat-transfer coefficient and the mass flow per unit area and by the similarity of the velocity fields behind the heat exchanger and by the visualization of the condensate flux. As a result the heat exchanger size to be tested can be reduced to a minimal height of 500 mm. It is pointed out that the data found for finned air coolers can also be applied for most of the heat recovery designs. The laboratory experiments have created valuable expertise about the measuring and testing technique. A new evaluation and plot of the test results are suggested by which the heat exchanger characteristic can be described by only one plot even for the wet cooler.

39357 (INIS-mf—10675) Aerosol sensor: Real time determination of aerosol mass size distributions by means of filtrating quartz oscillators. Final report. (Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)). 1985. 23p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-08345.

Irradiating quartz crystals of approx. 100 μm thickness with heavy ions (e.g. /sup 238/U, 17 MeV/n, 10/sup 5/ ions/cm/sup 2/) creates heavy damage of the crystal structure along the path. Etching these quartzes with e.g. KOH produces pores with adjustable diameter. We investigated the possibility of using these quartzes as filtering mass monitoring devices. As a result we obtained a reduced Q-factor compared to untreated quartzes but still the quartzes can be employed as oscillators. Their moisture sensitivity and temperature coefficients are similar to those of normal quartzes. Their typical mass response is approx. 1 Hz/(ng/cm/sup 2/). The pores have funnel shape so that cascading to obtain mass size distributions is difficult.

39358 (JAERI-M—86-123) Inverse kinematics of a manipulator. The inverse Jacobian method and treatment at singular points. Suzudo, Tomoaki. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 37p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702522.

The inverse Jacobian method based on the linearization of manipulator kinematics equation is generally used for obtaining its inverse kinematic solutions. In the present study, a robot manipulator having 6 degrees of freedom is analyzed for specified positions and orientations and the accuracies and limitations of the method are discussed. Generally speaking, the inverse Jacobian method cannot be applied when it is singular. However, it is possible to find a regular minor matrix and to obtain its inverse transformation. Based on this concept, a method has been developed which can be applied for obtaining the inverse transformation for manipulators at their singular points. It has been confirmed that the present method can give inverse kinematic solutions for manipulators with the same order of accuracy at singular points as those obtained at nonsingular points from a practical view point.

39359 (KFK—4200) Robotics in Japan. A travel report. Martin, T. (ed.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraegerschaft Fertigungstechnik). Feb 1987. 184p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-08453.

In September 1986, a group of German scientists visited Japanese institutions dealing with advanced robotics research, to gain a deeper insight in the Japanese status of this technology. Research projects found and discussions led in seven leading research institutes and seven firms are reported. Advanced robot or handling systems to ease or avoid human exposure to activities in harsh, demanding or dangerous conditions or environment are mainly dealt with. The Japanese show vast research activities in this area in the pre-competitive stage especially in the nuclear and underwater application area.

39360 **(NP—7770142) Status report: Prospect drilling technique.** Behrens, J.; Marx, C.; Schlueter, H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). May 1981. 245p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770142.

An attempt is made to give a survey of the available drilling systems (processes and equipment), which are used in prospect drilling. Starting from the diamond core drilling technique system, the systems are described which can be distinguished according to the drilling machine used (spindle drilling machine - drilling gun). Apart from the conventional diamond core drilling, the wire line system (inner core which can be pulled out) and the Diamec system of fully mechanised drilling guns are picked out as independent systems. The rotary drilling system (which is occasionally used in prospect drilling) is characterized and described. The counterflush process and the directional drilling technique are shown as special and independent systems. Finally, those systems are introduced, which have not been used much in prospect drilling technique: flexidrilling, the use of drilling tools which can be withdrawn and new types of processes for destroying rock. (orig./MOS).

39361 **(NP—7770147) Pressure of earth on pipelines in mining pressure areas. Final report.** Kratzsch, H. (Technische Univ. Berlin (Germany, F.R.)). 25 Mar 1986. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87770147.

The aim of the research project was, by using model calculations according to the finite element method, to determine the rise of radial soil stresses on the pipe circumference of a supply pipe. The results are shown and discussed. The different material parameters for the selection of the types of soil and the material properties of the soils during various load phases are described. The investigation was done on the empty pipe and for pipeline with various internal pressures.

39362 **(NP—7770153) Basis, method of operation and components of modern drilling engines.** Nacke, L. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1985. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770153.

Part 1 of this paper deals with the basis of the operation and the components of drilling engines. The principles of drilling turbines and Moineau drives are described and the design parameters are derived. The method of operation of the drilling turbine is determined by the change of tangential flow speed of the drilling fluid in the guide values. In hydrostatic drilling engines, the pressure drop in the engine determine the operating characteristics.

39363 **(ORNL/M—350) General information and guide for the neutron and x-ray facilities of the National Center for Small-Angle Scattering Research.** (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012334.

The 30-m SANS instrument, 10-m SAXS camera, 10-m SANS instrument, and the high-resolution double-crystal SANS instrument are described. Brief descriptions are given of proposal guidelines, measurements, and publications. (WRF)

39364 **(PNL-SA—14058) Design of a distributed control system for a robotic mannequin.** Gilbert, R.W.; Cheatham, R.L.; Hof, P.J.; Anderson, G.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 7p. (CONF-870301—23). NTIS, PC A02. File Number DE87011157.

From International topical meeting on remote systems and robotics in hostile environments; Pasco, WA, USA (29 Mar 1987).

A robotic mannequin with thirty-eight degrees of movement freedom has been designed and is currently being developed by engineers at Pacific Northwest Laboratory. The mannequin will be used to test the effectiveness of protective clothing in hazardous environments. By simulating human movements and positions, the mannequin will be able to test the effectiveness of protective clothing in a realistic, workplace environment. The accuracy afforded by the mannequin has not been possible to date without using human testers. In addition to this realistic environment, reproducible and standardized testing will be achieved by using the mannequin's programmed and repetitive test routines. During testing, special sensors will detect any penetration of the protective clothing by the hostile environment. The robotic mannequin's control system provides the control and monitoring functions necessary to allow coordinated movement of multiple joints and also controls the ancillary systems: breathing, perspiration, skin heating, sampling of chemical reagents, and test data recording.

39365 **(PNL-SA—14440) Design, construction, and testing of an anthropomorphic robot.** Bennett, D.W.; Yount, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 14p. (CONF-870301—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011141.

From International topical meeting on remote systems and robotics in hostile environments; Pasco, WA, USA (29 Mar 1987).

The objective of the mannequin project is to provide a poseable anthropomorphic robot for use in experimental studies of the effectiveness of protective clothing in hostile environments. The effects of wear and exercise of protective clothing will be evaluated with respect to the effects of body articulation, representative skin temperature, perspiration, and breathing. The mannequin will serve two primary functions. First, it will be used to study penetration of the protective clothing by the hostile environment. The mannequin will be outfitted with a variety of clothing and equipment to serve this function. Second, the mannequin will be capable of anthropomorphically and repetitively exercising a variety of protective clothing and equipment in simulated and variable field conditions without committing man to the hostile environment.

39366 **(SAND—87-0021C) Compound semiconductor heterojunction device technologies for high-temperature ($T > 300^{\circ}C$), power electronics.** Zipperian, T.E.; Brennan, T.M.; Hammons, B.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870804—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010475.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Recent advances in compound semiconductor materials and devices are reviewed as they relate to electronics intended for power switching and control applications at temperatures in excess of 300°C. The problems faced by solid-state devices operating simultaneously at high currents, voltages, and temperatures are detailed and solutions offered by the use of alternative materials such as GaAs, GaP, (Al,Ga)As, and (Al,Ga)P, and use of novel heterojunction techniques for the control of parasitics, are presented. Prototype, low-power, (Al,Ga)As/GaAs heterojunction diodes, bipolar transistors, and semiconductor controlled rectifiers are described which have demonstrated excellent electrical characteristics in the 300 to 400°C temperature range. These studies imply that a heterojunction, (Al,Ga)As/GaAs, power semiconductor electronics technology is feasible in the near future.

39367 (SAND—87-0482C) The LPX [Long Pulse eXperiment] facility. Ginn, J.W.; Hendricks, D.N.; Clark, M.C.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-8706133—1-Abst.). NTIS, PC A02. File Number DE87010493.

From IEEE international conference on plasma science; Washington, DC, USA (1 Jun 1987).

This paper investigates the load on the Long Pulsed eXperiment (LPX) facility which consists of a magnetically-insulated, line-limited, saturated parapotential-flow diode. In particular, the scaling of the saturated parapotential flow into the microsecond time regime is looked at. Key issues include plasma closure and the presence of ion contamination leading to bipolar flow. View graphs data are provided. (LSP)

39368 (SAND—87-0646C) Current development needs in the control of teleoperated vehicles. McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8706122—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010685.

From Artificial intelligence and robotics symposium; Norfolk, VA, USA (16 Jun 1987).

Teleoperated land vehicles of various types have been developed, studied and used for many years. In order to control the motion of these vehicles, the human operator must be provided with knowledge of the environment in which the vehicle is operating and with some type of feedback on vehicle motion. Experimental studies of remote driving are reviewed to approach an understanding of these control requirements. Due to the relative sparseness of data, it is also necessary to investigate the related technologies of vision, kinesthetic feedback, training, and performance measurement. Through this review, a number of significant areas requiring additional development work are identified.

39369 (SAND—87-0810C) Reachable workspace of two planar 3R cooperating manipulators. Palmquist, R.D.; Duffy, J. (Sandia National Labs., Albuquerque, NM (USA); Florida Univ., Gainesville (USA). Center for Intelligent Machines and Robotics). 1987. Contract AC04-76DP00789. 7p. (CONF-870852—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007863.

From ASME computers in engineering conference; New York, NY, USA (9 Aug 1987).

The issue of having adjacent manipulators cooperate with each other in performing a given task has received increasingly more attention over the past few years. These manipulators could be on a manufacturing line, perhaps the legs of a walking machine, or even the fingers of a mechanical hand. In each case, the same type of geometric and kinematic analysis can apply. In this paper the reachable workspace associated with such a manipulator pair is addressed. By way of example, two planar 3R robots operating in tandem are used. This then provides a foundation for extension to other types of planar and spatial manipulators.

39370 (SAND—87-0864C) Dexterity of two planar 3R cooperating robots. Palmquist, R.D.; Duffy, J. (Sandia National Labs., Albuquerque, NM (USA); Florida Univ., Gainesville (USA). Center for Intelligent Machines and Robotics). 1987. Contract AC04-76DP00789. 8p. (CONF-870852—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007843.

From ASME computers in engineering conference; New York, NY, USA (9 Aug 1987).

The reachable and dexterous workspaces are significant parameters in evaluating the performance characteristics of a given manipulator. This also applies to manipulator pairs working together to perform a given task. This task could be assembling a workpiece on a manufacturing line, working the fingers of a mechanical hand in harmony to pick up an object, or perhaps coordinating the motion of the legs of a walking machine. In each case, optimizing these workspaces becomes important. In the companion paper, "Reachable Workspace of Two Planar 3R Cooperating Manipulators," the reachable workspace of these manipulator pairs was addressed. Here, the issue of dexterity is investigated. Specifically, the dexterous properties of a single planar 3R manipulator are reviewed. Building on these ideas, the dexterity of a pair of these planar robots is then analyzed. In accomplishing this, we define the term "tandem dexterity" and classify the different dexterity forms. We present some applications of this dexterity analysis, showing how it can be used in typical tasks employing such manipulator pairs.

39371 (UCRL—93745) The effect of the failure criterion in the numerical modeling of orthogonal metal cutting. Riddle, R.A. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 34p. (CONF-8704116—2-Abst.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010806.

From IMOG metal forming modeling subgroup; Livermore, CA, USA (22 Apr 1987).

Numerical modeling of metal cutting using the finite element method has been successfully used to show that assumed material properties have a large effect on such machining process parameters as the required tool forces, chip morphology, and residual stresses in the finished surface. Finite element results show that workpiece material properties such as assumed isotropic or kinematic hardening, the work hardening and work softening stress-strain behavior, the friction factor between the tool and the workpiece materials, and the failure criterion for the workpiece material all have a significant effect on the predicted cutting forces, chip shape, and workpiece residual stresses. The failure criterion for the workpiece material in the numerical modeling is used to describe the separation of the chip from the workpiece at the tool tip.

39372 (UCRL—96708) LLNL machine tool services preventative maintenance program using the VAX 11-785 computer cluster. Smith, T.D. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 15p. (CONF-8706108—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010809.

From Maintenance seminar; Oak Ridge, TN, USA (2 Jun 1987).

This paper describes a new Preventative Maintenance Program recently put into effect in Materials Fabrication Division at Lawrence Livermore National Laboratory. The purpose of this program is to minimize downtime of important machine tools and help ensure a safer working environment for employees. Close attention is also paid to cost effectiveness of prolonging the usable life of machine tools. Small overlooked problems, such as a lube failure, can be expensive, whereas over zealous preventative maintenance can needlessly use up manpower and materials.

39373 Beneficial Uses Shipping System Cask. Yoshimura, H.R.; Wellman, G.W.; Moya, J.L.; Gonzales, A.; Gwinn, K.W.; Eakes, R.G.; Uncapher, W.L.; Bronowski, D.R. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Beneficial Uses Shipping System (BUSS) cask is a Type B packaging currently under development at Sandia National Laboratories for the US Department of Energy (DOE). The cask will transport radioactive source capsules (CsCl and SrF_2) to facilities such as sewage, food, and medical-product irradiators. The paper describes the cask system and the analyses performed to predict the response of the cask in impact, puncture, and fire-accident conditions as specified in the regulations. The cask prototype is being fabricated, and activities to obtain a certificate of compliance have been initiated. 15 references, 5 figures, 3 tables.

39374 **Cask performance and interface specifications for shipment of US spent light-water-reactor fuel.** Sanders, T.L.; Allen, G.C. Jr.; Wilmot, E.L. (Sandia National Labs., Albuquerque, NM; Dept. of Energy, Washington, DC). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Preliminary cask physical-performance specifications and interface guidelines have been defined to support the development of a family of casks and transporters for shipments in the United States of America of spent light-water-reactor fuel. These shipments will be made from US commercial reactor facilities to high-level-waste receiving facilities. The specified hardware consists of both truck and rail/barge casks, along with their associated transporters. 8 references, 1 figure.

39375 **Application of SCALE to the analysis of spent fuel casks.** Parks, C.V. (Oak Ridge National Lab., TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The SCALE computational system was developed at the request of the United States Nuclear Regulatory Commission for use in cask license review and analysis. Of late, the system has been used in an increasing number of applications as its ease of use and versatility have become more widely known. The paper provides a brief review of the SCALE system and highlights various Oak Ridge National Laboratory applications of SCALE to illustrate the degree of standardization and simplification that the system can bring to design and review analyses of spent fuel casks. Poster presentation. 5 references, 3 figures, 3 tables.

39376 **Drop testing at the Oak Ridge National Laboratory.** Shappert, L.B.; Box, W.D. (Oak Ridge National Lab., TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Two full-scale packages designed to carry radioactive materials were drop tested at the Oak Ridge National Laboratory. The unique aspects of the tests are described. The first drop test series involved the 22,700 kg (50,000 lb) TRUPACT package. Because of the substantial thickness of foam insulation in the walls and the thin, outer steel shell, the rigging of the package for the series of seven drops was carefully designed not to cause damage to the package during the testing. Each impact had the potential to change the position of the waste containers inside the TRUPACT package. As a result, the centre of gravity (c.g.) of the package was determined between drops. The rigging was adjusted to ensure that the c.g. was in the proper location for the subsequent tests. Following the drop, the TRUPACT package was transferred to Sandia National Laboratories for further tests and evaluations. In the second series of tests, a full-size steel canister, constructed to transport spent Three Mile Island fuel, was dropped. These tests were designed to subject the package to the same shock environment it would experience if the cask carrying a similar canister were subjected to a 9 m drop as specified in the regulations. Energy absorbers were designed to provide the proper decelerations. One unique aspect of the tests involved the surrogate fuel, located inside the canister, which was frozen to ensure that the poison rods inside the canister would be subjected to a severe shock load. The package survived the tests as predicted. Poster presentation. 4 references, 2 figures, 1 table.

39377 **Radioactive particulate release from the DOT specification 6M container under hypothetical accident conditions.** Taylor, J.M.; Raney, P.J. (Battelle Pacific Northwest Labs., Richland, WA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

A testing programme was conducted to determine the amount of depleted uranium dioxide powder (DUO) that would leak from the inner-containment components of the United States Department of Transportation's (DOT) specification 6M container under hypothetical accident conditions. Depleted uranium dioxide was selected as a surrogate for plutonium oxide because of the similarities in powder characteristics, density, and particle size and because of the special handling and special facilities required for plutonium oxide. The DUO was packaged inside food-pack cans and then placed inside the 2R vessel of the 6M container. The gas rates of the food-pack cans tested ranged from 1.6 cm^3/s to approximately 38-cm^3/s. The packaging configurations were subjected to 9-m drops, 1-m drops onto a 15-cm diameter cylinder and to heating (inner vessel only) at 150°C in a furnace that could be rotated and vibrated. The DUO leakage rate from the containment barriers after the impact and heating tests was measured using a dissolution technique and a laser fluorometer. The amount of DUO powder leakage ranged from nothing detectable to a high of $1x10^{-4}$ g. Impact forces had no effect on the leakage of particles with the packaging configurations used. The tests showed that when the gas leak rate was between 1.6 cm^3/s and 3.2 cm^3/s, the amount of particulate material that could be transmitted through the leak sites would be less than the allowable release limits ($<3x10^{-8}$ g/h) of plutonium. Poster presentation. 5 references, 2 figures, 2 tables.

39378 **Testing of the DHLW truck-shipping cask.** Madsen, M.M.; Uncapher, W.L.; Stenberg, D.R.; Zimmer, A.; Koploy, M.; Schlafer, W. (Sandia National Labs., Albuquerque, NM; GA Technologies, Inc., San Diego, CA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Defense High Level Waste (DHLW) cask is a Type B packaging currently under development by the United States Department of Energy (DOE). The shipping system is designed to meet a legal truck weight limit of 36,288 kg (80,000 lb). Type B packagings for transporting radioactive materials are required to maintain containment and shielding after being exposed to the environments defined in Title 10, Code of Federal Regulations, Part 71. A combination of testing and analysis is used to verify the adequacy of the cask design. The paper describes the test-programme portion of the design verification. Poster presentation. 4 references, 7 figures, 1 table.

39379 **Impact, puncture, and thermal testing of TRUPACT-I.** Romesberg, L.E.; Hudson, M.L. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Transuranic Package Transporter (TRUPACT-I) is a packaging developed by the United States Department of Energy (DOE) for transporting contact-handled transuranic waste (CH-TRU) in the USA. A full-scale prototype was built and subjected to a series of drop, puncture, and thermal tests to evaluate the

package's resistance to normal handling and hypothetical accident conditions. A thermal redesign and component test programme was conducted when the prototype failed to maintain containment after the thermal test. A thermal test packaging which included previously incurred structural damage was tested to demonstrate the adequacy of the new design features in an open pool-fire environment. Since no detectable leaks were measured from the filter seals and valves and the seal leak rate was less than the maximum allowable, containment was demonstrated. 5 references, 1 figure, 1 table.

39380 **Shock and vibration environments. Road simulator tests.** Glass, R.E.; Gwinn, K.W. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The study was undertaken as an element of a programme directed at determining the shock and vibration environments encountered during the normal transportation of nuclear materials. Previous data for a large number of shipments were reviewed and over-the-road tests were conducted. These previous efforts resulted in a shock-spectra description which bounds the environments anticipated during normal shipment. The study seeks to extend these results. This goal is being accomplished with road-simulator experiments and the continued development of an analytical model. The results will be an improved ability to predict the shock and vibration environment for a given shipment and an improved ability to design critical elements of the system, such as tie-downs. The paper discusses the experimental programme. The experiments consisted of two road-simulator tests. The system response and the known input resulted in defined frequency-response functions for the system. These results provide the final data required for the development and verification of an analytical model.

39381 **Analysis of the DHLW cask under normal and hypothetical accident-condition loads with initial pressure.** Koploy, M.; Schlafer, W.; Urias, P.; Zimmer, A.; Warrant, M.M. (GA Technologies, Inc., San Diego, CA; Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The paper describes analyzes performed for the Defense High-Level Waste (DHLW) cask design that establish an upper limit of 700 lbf/in^2 (1 lbf/in^2(g) = 6.895x10^3 Pa) for the cask maximum normal operating pressure (MNOP). Analyses of the cask with this MNOP as an initial condition show that for both normal and hypothetical accident conditions of transport, the stresses are within allowable values. Poster presentation. 2 references.

39382 **Containment analysis of TRUPACT-I.** Warrant, M.M.; Nelsen, J.M.; Woolfolk, S.W. (Sandia National Labs., Albuquerque, NM; Remote Sensing System, Inc., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

TRUPACT-I is a packaging which will be used to transport contact-handled transuranic (CH-TRU) wastes generated by defense programmes in the United States of America. The paper presents a general approach to the containment analysis for TRUPACT-I. The maximum activity per TRUPACT-I packaging is determined for a stated seal leak rate and filter penetration efficiency in order to comply with regulatory release limits for normal and hypothetical accident conditions. Poster presentation. 5 references, 1 figure, 1 table.

39383 **Design and scale-model testing of the NuPac 125-B rail cask.** Haelsig, R.T.; Warrant, M.M.; Joseph, B.J.; Quinn, G.J.; Burton, H.M. (Nuclear Packaging Corp., Federal Way, WA; Sandia National Labs., Albuquerque, NM; EG and G, Inc., Middletown, PA; UNC Nuclear Industries, Inc., Richland, WA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The NuPac 125-B package was developed for defueling the damaged Three Mile Island Unit II (TMI-2) reactor. The nature and impact of these requirements on the design and licensing of a transport package are discussed. Loading and unloading of the NuPac 125-B differs from conventional fuel-cask-handling procedures owing to facility features and limitations at both TMI-2 and the receiving station. All transfers are dry and the cask is never placed in a conventional fuel-loading pool. In addition, the cask design was affected by the unique requirements for double containment of the TMI-2 fuel material, an accelerated development schedule, and limits imposed on impact loads experienced by the fuel-debris canisters. Licensing activities involved analyses correlated with drop and puncture tests conducted on a 1/4-scale cask model. All structural details of the NuPac 125-B were accurately represented in these tests and analyses. Excellent correlation was found between analytical predictions and model behaviour on the impact events, and basic structural design and analysis assumptions were validated. Used together, integrated test and analysis demonstrations are shown to accelerate the design and licensing process. 2 references, 1 figure.

39384 **Target-hardness comparisons with the IAEA unyielding target.** Gonzales, A.; Pierce, J.D.; Stenberg, D.R. (Sandia National Labs., Albuquerque, NM; Southwest Engineering Associates, El Paso, TX). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Various types of targets were compared with respect to their hardness upon a cask-type object. A cylindrically shaped unit was impacted into soil, concrete, and rigid targets at velocities ranging from 13 m/s (44 ft/s) to 27 m/s (88 ft/s). Experimental and analytical results were compared to better understand the responses generated by different targets to a projectile. Poster presentation. 6 references, 2 figures, 2 tables.

39385 **Personal-computer program for evaluating the impact of prosposed cask design specifications.** Bucholz, J.A. (Oak Ridge National Lab., TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

4203 Lasers

REFER ALSO TO CITATION(S) 39232, 39322, 40176, 40187

39386 **(AD-A—179746/3/XAB) Investigation of absolute stability of water-vapor-stabilized semiconductor laser.** Pevtschin, V.; Ezekiel, S. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Mar 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 3, 172-174(Mar 1987).

The absolute stability of a semiconductor laser that is stabilized to an absorption line in water vapor was investigated by using an independent water-vapor cell. A shift in frequency of about 1 part in 10^8 per degree Celsius was measured and attributed to temperature-dependent pressure shift in water vapor.

39387 **(AD-A—179761/2/XAB) Mixed-mode phase-locked quantum-well laser arrays.** Towe, E.; Fonstad, C.G. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Dec 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Proceedings of the International Electron Devices Meeting, 626-629(Dec 1986).

The fabrication and characterization of a new type of phase locked laser array that displays narrow, single-lobe far-field patterns is reported. The new array achieves phase-locking through coupling by diffraction in a central section where the propagating eigenmodes are unguided. The light is guided in parallel-element waveguides on either side of the central mode mixing region.

39388 **(AD-A—179962/6/XAB) Narrow-linewidth, single-frequency semiconductor laser with a phase-conjugate external-cavity mirror.** Vahala, K.; Kyuma, K.; Yariv, A.; Kwong, S.K.; Cronin-Golomb, M. (California Inst. of Tech., Pasadena (USA)). 8 Dec 1986. 4p. NTIS, PC A02/MF A01.

Pub. in Applied Physics Letter, Vol. 49, No. 23, 1563-1565(8 Dec 1986).

Spectral characteristics of an external-cavity semiconductor laser, which uses a phase-conjugate mirror for its external reflection were measured. This device has significant advantages over the conventional external-cavity system owing to the self-aligning nature of the phase-conjugate mirror. The fiber delay line self-heterodyne technique is used to measure the fundamental linewidth for single-mode operation of this device. It shows the linewidth to be at least as narrow as the instrumental resolution of 100 kHz.

39389 **(AD-A—179999/8/XAB) Modification of electron-cyclotron maser operation by application of an external signal. Final report.** McCurdy, A.H.; Armstrong, C.M.; Bollen, W.M. (Naval Research Lab., Washington, DC (USA)). 31 Mar 1987. 32p. (NRL—9038). NTIS, PC A03/MF A01.

Operation of the electron cyclotron resonance maser (ECRM) when subjected to an external rf signal is studied. The signal is introduced both by direct injection through a coupling hole in the oscillator and by modulating the electron beam in separate cavities, upstream of the oscillator. Experiments using both one and two pre bunching cavities are reported. It is found that the gyromonotron, a specific embodiment of the ECRM, can be phase locked by premodulating the electron beam. In this case, the required drive power levels are more than 15 dB below that predicated by Adler's widely applicable theory for single-cavity oscillators. In addition, the same method allows oscillator phase-locked systems, significant reduction of frequency, and amplitude noise is observed within the locking band in signal of a power level 65 dB below that of the oscillator. The general amplitude and frequency response of the ECRM to an applied external signal is also investigated. Three distinct regions of qualitatively different behavior are noted: soft excitation, which is free, self-excited oscillation; hard excitation, where the oscillation requires an external impulse for start up; and amplifier, in which the output power level and frequency are linearly related to the drive in the small regime.

39390 (DOE/DP/40152—17, pp 107-117) **Chemical oxygen-iodine laser.** Moncur, N.K. (ed.). Mar 1986. NTIS, PC A07/MF A01. File Number DE87010564.

In Inertial fusion research: Annual technical report, 1985.

An inertial confinement fusion (ICF) power plant requires a driver that can deliver both high peak and high average power to small targets. This driver must be very efficient and capable of a high pulse rate (of order 10 Hz). If it is a laser, it must also produce short-wavelength light. The chemical oxygen-iodine laser (COIL) has the potential to meet many of these requirements and is a strong candidate for use as a fusion driver. A program to evaluate the COIL is underway at KMS Fusion (KMSF). An assessment of chemical kinetics issues that affect the efficient extraction of energy in short high-power pulses has been done. A laboratory facility has been constructed that contains a peroxide/chlorine singlet oxygen generator and a fast-flow gas-handling system. In this report, the design criteria for the singlet oxygen generator and the cold traps that are the heart of the gas-handling system are discussed.

39391 **(LA—11049-MS) A review of experimental data for energy transfer processes involving CO_2 in a D_2-F_2-CO_2 laser.** Feber, R.C.; Sullivan, J.H. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012393.

The bending and symmetric stretch vibrational modes of CO_2 in a D_2-F_2-CO_2 laser are shown to have a common vibrational temperature. This means that an appreciably limited number of energy transfer processes are sufficient to model the behavior of the laser. The experimental measurements of the rates of these processes are reviewed, and recommended expressions for the rate coefficients are given.

39392 **(LA-UR—87-1480) Optical resonator design studies for high gain free electron lasers.** McVey, B.D.; Tokar, R.L.; Bender, S.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870623—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010099.

From 22. AIAA thermophysics conference; Honolulu, HI, USA (8 Jun 1987).

Optical resonator design studies have been performed for free electron laser oscillator configurations driven by an rf linac. The resonator designs were for an FEL configuration with large saturated gain (50 to 100%) through the electron beam-wiggler region. For the case of large saturated gain, the power loading on the mirrors is reduced, however, the resonator design must compensate for the optical gain and refractive properties of the electron beam.

39393 **(N—87-20522) Closed-cycle, frequency-stable CO_2 laser technology.** Batten, C.E.; Miller, I.M.; Wood, G.M. Jr.; Willetts, D.V. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1987. 279p. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—). NTIS, PC A13/MF A01.

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

These proceedings contain a collection of papers and comments presented at a workshop on technology associated with long-duration closed-cycle operation of frequency-stable, pulsed carbon dioxide lasers. This workshop was held at the NASA Langley Research Center June 10 to 12, 1986. The workshop, jointly sponsored by the National Aeronautics and Space Administration (NASA) and the Royal Signals and Radar Establishment (RSRE), was attended by 63 engineers and scientists from the United States and the United Kingdom. During the 2 1/2 days of the workshop, a number of issues relating to obtaining frequency-stable operation and to the catalytic control of laser gas chemistry were discussed, and specific recommendations concerning future activities were drafted.

39394 (N—87-20522, pp vp) **Review of the frequency stabilization of TEA CO_2 laser oscillators.** Willetts, D.V. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Most applications of TEA CO_2 lasers in heterodyne radar systems require that the transmitter has a high degree of frequency stability. This ensures good Doppler resolution and maximizes receiver sensitivity. However, the environment within the device is far from benign with fast acoustic and electrical transients being present. Consequently the phenomena which govern the frequency stability of pulsed lasers are quite different from those operative in their CW counterparts. This review concentrates on the mechanisms of chirping within the output pulse; pulse to pulse frequency drift may be eliminated by frequency measurement and correction on successive pulses. It emerges that good stability hinges on correct cavity design. The energy-dependent laser-induced frequency sweep falls dramatically as mode diameter is increased. Thus, it is necessary to construct resonators with good selectivity for single mode operation while having a large spot size.

39395 (N—87-20522, pp vp) **Large mode radius resonators.** Harris, M.R. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Resonator configurations permitting operation with large mode radius while maintaining good transverse mode discrimination are considered. Stable resonators incorporating an intracavity telescope and unstable resonator geometries utilizing an output coupler with a Gaussian reflectivity profile are shown to enable large radius single mode laser operation. Results of heterodyne studies of pulsed CO_2 lasers with large (11mm e sup-2 radius) fundamental mode sizes are presented demonstrating minimal frequency sweeping in accordance with the theory of laser-induced medium perturbations.

39396 (N—87-20522, pp vp) **Analysis of intrapulse chirp in CO_2 oscillators.** Moody, S.E.; Berger, R.G.; Thayer, W.J. III. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Pulsed single-frequency CO_2 laser oscillators are often used as transmitters for coherent lidar applications. These oscillators suffer from intrapulse chirp, or dynamic frequency shifting. If excessive, such chirp can limit the signal-to-noise ratio of the lidar (by generating excess bandwidth), or limit the velocity resolution if the lidar is of the Doppler type. This paper describes a detailed numerical model that considers all known sources of intrapulse chirp. Some typical predictions of the model are shown, and simple design rules to minimize chirp are proposed.

39397 (N—87-20522, pp vp) **Frequency stabilization in injection controlled pulsed CO_2 lasers.** Menzies, R.T.; Ancellet, G.M. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Longitudinal mode selection by injection has been demonstrated as a viable technique for tailoring a TEA-CO_2 laser with pulse energies of a Joule or greater to fit the requirements of a coherent lidar transmitter. Once reliable generation of single-longitudinal-mode (SLM) pulses is obtained, one can study the intrapulse frequency variation and attempt to determine the sources of frequency sweeping, or chirp. These sources include the effect of the decaying plasma, the thermal gradient due to the energy dissipation associated with the laser mechanism itself, and the pressure shift of the center frequency of the laser transition. The use of the positive-branch unstable resonator as an efficient means of coupling a discharge with transverse spatial dimensions of the order of centimeters to an optical cavity mode introduces another concern: namely, what can be done to emphasize transverse mode discrimination in an unstable resonator cavity while maintaining high coupling efficiency. These issues are briefly discussed in the paper, and representative experimental examples are included.

39398 (N—87-20522, pp vp) **High repetition rate sealed CO_2 TEA lasers using heterogeneous catalysts.** Price, H.T.; Shaw, S.R. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

The significant operational advantages offered by CO_2 lasers, operating in the 10.6 micron region of the spectrum, over current solid state lasers, emitting in the near IR region, have prompted increased interest in the development of compact, reliable, rugged CO_2 laser sources. Perhaps the most critical aspect associated with achieving a laser compatible with military use is the development of lasers which require no gas replenishment. Sealed, single shot, CO_2 TEA lasers have been available for a number of years. Stark, et al, were first to demonstrate reliable sealed operation in single shot CO_2 TEA lasers in 1975 using gas catalysis. GEC Avionics reported the compact, environmentally qualified, MKIII CO_2 TEA laser with a pulse life of greater than 10 to the 6th power pulses in 1980. A sealed laser lifetime of greater than 10 to the 6th power pulses is acceptable for single shot cases, such as direct detection rangefinders for tank laser sights. However, in many other applications, such as tracking of fast moving targets, it is essential that a repetition rate of typically 30Hz to 100Hz is employed. In such cases, a pulse lifetime of 10 to the 6th power pulses is no longer sufficient and a minimum pulse lifetime 10 to the 7th power pulses is essential to ensure a useful service life. In 1983 Stark, el al, described a sealed, 100Hz CO_2 TEA laser, with a life of greater than 2.6 x 10 to the 6th power, which employed heterogeneous catalysis. Following this pioneering work, GEC Avionics has been engaged in the development of sealed high repetition rate lasers with a pulse lifetime of 20 million pulses.

39399 (N—87-20522, pp vp) **Chemical engineering design of CO oxidation catalysts.** Herz, R.K. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

How a chemical reaction engineer would approach the challenge of designing a CO oxidation catalyst for pulsed CO_2 lasers is described. CO oxidation catalysts have a long history of application, of course, so it is instructive to first consider the special requirements of the laser application and then to compare them to the characteristics of existing processes which utilize CO oxidation catalysts. All CO_2 laser applications require a CO oxidation catalyst with the following characteristics: (1) active at stoichiometric ratios of O_2 and CO, (2) no inhibition by CO_2 or other components of the laser environment, (3) releases no particulates during vibration or thermal cycling, and (4) long lifetime with a stable activity. In all applications, low consumption of power is desirable, a characteristic especially critical in aerospace applications and, thus, catalyst activity at low temperatures is highly desirable. High power lasers with high pulse repetition rates inherently require circulation of the gas mixture and this forced circulation is available for moving gas past the catalyst. Low repetition rate lasers, however, do not inherently require gas circulation, so a catalyst that did not require such circulation would be favorable from the standpoint of minimum power consumption. Lasers designed for atmospheric penetration of their infrared radiation utilize CO_2 formed from rare isotopes of oxygen and this application has the additional constraint that normal abundance oxygen isotopes in the catalyst must not exchange with rare isotopes in the gas mixture.

39400 (N—87-20522, pp vp) **Catalysts for long-life closed-cycle CO_2 lasers.** Schryer, D.R.; Sidney, B.D.; Miller, I.M.; Hess, R.V.; Wood, G.M.; Batten, C.E.; Burney, L.G.; Hoyt, R.F.; Paulin, P.A.; Brown, K.G. (Old Dominion Univ., Norfolk, VA). Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Long-life, closed-cycle operation of pulsed CO_2 lasers requires catalytic CO-O_2 recombination both to remove O_2, which is formed by discharge-induced CO_2 decomposition, and to regenerate CO_2. Platinum metal on a tin (IV) oxide substrate (Pt/SnO_2) has

been found to be an effective catalyst for such recombination in the desired temperature range of 25 to 100 C. This paper presents a description of ongoing research at NASA-LaRC on Pt/SnO_2 catalyzed $CO-O_2$ recombination. Included are studies with rare-isotope gases since rare-isotope CO_2 is desirable as a laser gas for enhanced atmospheric transmission. Results presented include: (1) achievement of 98% to 100% conversion of a stoichiometric mixture of CO and O_2 to CO_2 for 318 hours (greater than 1 x 10 to the 6th power seconds), continuous, at a catalyst temperature of 60 C, and (2) development of a technique verified in a 30-hour test, to prevent isotopic scrambling when CO-18 and O-18(2) are reacted in the presence of a common-isotope Pt/Sn O-16(2) catalyst.

39401 (N—87-20522, pp vp) **Strong metal-support interactions.** Vannice, M.A. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

It has been demonstrated that synergistic metal-support effects can occur which markedly enhance specific activity and alter selectivity in certain reactions. Because of the presence of such effects in certain reactions conducted under reducing conditions (that is, under H_2 pressure), but not others, the creation of unique sites at the metal-support interface seems to be the best model at the present time to explain this behavior. The postulation of these sites, which are specific for a certain reactant such as CO, provides an effective explanation for the higher methanation rates that have been reported over some catalysts. The creation of these sites in the adlineation zone is facilitated by hydrogen spillover from the metal surface, and this same process can also enhance the reduction of many oxide supports. Although oxygen spillover is much less probable due to its higher heat of adsorption, it is much less well understood and the possibility of rate enhancements in CO oxidation caused by special interface sites cannot be discounted at the present time. Consequently, this seems to be an important area of future research.

39402 (N—87-20522, pp vp) **Characterization of the LTC catalyst: Performance against common air pollutants.** Collins, M.F. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

One of the important qualities of the Low-Temperature Catalyst (LTC) is the rapid oxidation of carbon monoxide to carbon dioxide under a wide variety of conditions. The catalytic material is a palladium-copper activated complex which reacts with various contaminant molecules through a continuous oxidation/reduction cycle. The alumina substrate enhances LTC activity with its favorable surface chemistry and very high surface area. About 10 percent surface water is necessary to facilitate the oxidation of CO. This reaction shows a log-log dependence on contact time, suggesting a Langmuir-Hinshelwood mechanism. In the tube tests, LTC removed 90 to 100 percent of contaminating carbon monoxide in the temperature region of 20 to 4000 C, and at ambient over a range of 25 to 65 percent relative humidity. In contrast, NO_2 is chemisorbed by the LTC/alumina material--the amount strongly dependent on temperature increases but independent of humidity. The LTC catalyst has demonstrated excellent capability to remove an important variety of hazardous pollutant gases which are common factors to poor indoor air quality. The Instapure Air Filtration System incorporates the LTC catalyst in a 50:50 mixture with activated carbon to effectively remove particulate, odors, and hazardous gases at room temperature and humidities. The ability to remove hazardous gases is unique for the category of portable air filtration equipment. The wide variety of pollutant gases that LTC removes suggests that catalytic technology is adaptable to a considerable range of commercial and industrial applications.

39403 (N—87-20522, pp vp) **Alumina-supported Pd-Ag catalysts for low-temperature CO and methanol oxidation.** Mccabe, R W. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Pd-Ag bimetallic catalysts, supported on gamma-Al_2O3#, have been evaluated as exhaust catalysts for methanol-fueled vehicles. Laboratory studies have shown that a 0.01% Pd-5% Ag catalyst has greater CO and CH_3OH oxidation activity than either 0.01% Pd or 5% Ag catalysts alone. Moreover, Pd and Ag interact synergistically in the bimetallic catalyst to produce greater CO and CH_3OH oxidation rates and lower yields of methanol partial oxidation products than expected from a mixture of the single-component catalysts. The Pd-Ag synergism results from Pd promoting the rate of O_2 adsorption and reaction with CO and CH_3OH on Ag. Rate enhancement by the bimetallic catalyst is greatest at short reactor residence times where the oxygen adsorption rate limits the overall reaction rate.

39404 (N—87-20522, pp vp) **Review of tin oxide-based catalytic systems: Preparation, characterization and catalytic behavior.** Hoflund, G.B. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

This paper reviews the important aspects of the preparation, characterization and catalytic behavior of tin oxide-based catalytic systems including doped tin oxide, mixed oxides which contain tin oxide, Pt supported on tin oxide and Pt/Sn supported on alumina. These systems have a broad range of applications and are continually increasing in importance. However, due to their complex nature, much remains to be understood concerning how they function catalytically.

39405 (N—87-20522, pp vp) **Rare isotope studies involving catalytic oxidation of CO over platinum-tin oxide.** Upchurch, B.T.; Wood, G.M. Jr.; Hess, R.V.; Hoyt, R.F. (Science and Technology Corp., Hampton, VA). Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Results of studies utilizing normal and rare oxygen isotopes in the catalytic oxidation of carbon monoxide over a platinum-tin oxide catalyst substrate are presented. Chemisorption of labeled carbon monoxide on the catalyst followed by thermal desorption yielded a carbon dioxide product with an oxygen-18 composition consistent with the formation of a carbonate-like intermediate in the chemisorption process. The efficacy of a method developed for the oxygen-18 labeling of the platinum-tin oxide catalyst surface for use in closed cycle pulsed carbon dioxide lasers is demonstrated for the equivalent of 10 to the 6th power pulses at 10 pulses per second.

39406 (N—87-20522, pp vp) **Studies of CO oxidation on Pt/SnO_2 catalyst in a surrogate CO_2 laser facility.** Batten, C.E.; Miller, I.M.; Paulin, P.A.; Schryer, J. (Old Dominion Univ., Norfolk, VA). Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Samples of 1% Pt/SnO_2 catalyst were exposed to a stoichiometric gas mixture of 1% CO and 1.2% O_2 in helium over a range of flowrates from 5 to 15 sccm and temperatures from 338 to 394 Kelvin. Reaction rate constants for the catalytic oxidation of carbon monoxide and their temperature dependence were determined and compared with previous literature values.

39407 (N—87-20522, pp vp) **Studies of long-life pulsed CO_2 laser with Pt/SnO_2 catalyst.** Sidney, B.D. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Closed-cycle CO_2 laser testing with and without a catalyst and with and without CO addition indicate that a catalyst is necessary for long-term operation. Initial results indicate that CO addition with a catalyst may prove optimal, but a precise gas mix has not yet been determined. A long-term run of 10 to the 6th power pulses using 1.3% added CO and a 2% Pt on SnO_2 catalyst yields an efficiency of about 95% of open-cycle steady-state power. A simple mathematical analysis yields results which may be sufficient

for determining optimum running conditions. Future plans call for testing various catalysts in the laser and longer tests, 10 to the 7th power pulses. A gas chromatograph will be installed to measure gas species concentration and the analysis will be slightly modified to include neglected but possibly important parameters.

39408 (N—87-20522, pp vp) **Characterization of Pt/SnO_2 catalysts for CO oxidation.** Brown, K.G.; Schryer, J.; Schryer, D.R.; Upchurch, B.T.; Wood, G.M.; Miller, I.M.; Sidney, B.D.; Batten, C.E.; Paulin, P.A. (Old Dominion Univ., Norfolk, VA; Science and Technology Corp., Hampton, VA). Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

Results are presented of surface characterization of 2% and 1% (w/w) Pt on SnO_2 catalysts which are being used in promoting the oxidation of CO in pulsed CO_2 lasers. The N_2 adsorption BET surface area for both catalysts is 6.9 sq m/g. The CO chemisorbed area at 313K is 0.17 sq m/g and 0.062 sq m/g for the 2% and 1% catalysts, respectively. Monitoring the reaction between CO and O_2 by the same technique, at the same temperature yields a turn-over frequency (TOF) for the 2% catalyst of 2.7 x 100 molecules of CO_2/site/s and for the 1% catalyst a value of 1.2 x 100. The ratio of the TOFs for the two catalysts is 2.2 which is approximately the ratio of the Pt loading.

39409 (N—87-20522, pp vp) **Overview of DREV's activities on pulsed CO_2 laser transmitters: Frequency stability and lifetime aspects.** Cruickshank, J.; Pace, P.; Mathieu, P. Apr 1987. NTIS, PC A13/MF A01. (NASA-CP—2456; L—16271; NAS—1.55:2456; CONF-8606324—).

From Closed-cycle, frequency-stable CO/sub 2/ laser technology; Hampton, VA, USA (10 Jun 1986).

After introducing the desired features in a transmitter for laser radar applications, the output characteristics of several configurations of frequency-stable TEA-CO_2 lasers are reviewed. Based on work carried out at the Defence Research Establishment Valcartier (DREV), output pulses are examined from short cavity lasers, CW-TEA hybrid lasers, and amplifiers for low power pulses. It is concluded that the technique of injecting a low-power laser beam into a TEA laser resonator with Gaussian reflectivity mirrors should be investigated because it appears well adapted to producing high energy, single mode, low chirp pulses. Finally, a brief report on tests carried out on catalysts composed of stannic oxide and noble metals demonstrates the potential of these catalysts, operating at close to room temperature, to provide complete closed-cycle laser operation.

39410 **(PB—87-186094/XAB) CO_2/TEA laser frequency-stabilized by phase conjugation. Final report.** (Societe Anonyme de Telecommunications, 75 - Paris (France)). Dec 1986. 81p. (In French). NTIS, PC PC E05/MF E04.

The original solution to the problem rests on a temporal application of the general phenomenon of phase conjugation; the creation of a nonlocalized mirror in a nonlinear medium by mixing degenerated to four waves and laser emission in a resonator represented by the mirror and a classical mirror: the optical frequency is no longer fixed by the geometrical mode of the cavity, but by the pumping frequency. Contrary to other studies, it was shown that, if the phenomena were to occur in an amplifying medium, strong reflectivity of the phase-conjugation mirror could be obtained with pumping powers close to 1 kW/sq cm, delivered by a low-power continuous laser. The mirror acts as a very narrow band filter, for which among the spontaneous radiations emitted by the CO_2 amplifier only those corresponding to the frequency of the pump will be reflected and thus amplified; the only condition is that the duration of the impulse must exceed the time of the path round trip of the light in the cavity. Emission of the TEA laser will therefore be brought under control on that of the continuous laser, and the frequency stabilities of the two lasers will be equivalent.

39411 **(UCRL—95881) Nd:Cr:GSGG [gadolinium scandium gallium garnet], will it replace Nd:YAG [yttrium aluminum garnet]?.** Stokowski, S.E. (Lawrence Livermore National Lab., CA (USA)). 7 Jan 1987. Contract W-7405-ENG-48. 17p. (CONF-870132—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008848.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

Gadolinium scandium gallium garnet (GSGG) codoped with neodymium (Nd) and chromium (Cr) is a new laser material that can make more efficient lasers. It is compared to Nd-doped yttrium aluminum garnet (YAG) for two types of systems: large zig-zag slab lasers and small rod lasers. Nd:Cr:GSGG has a significant advantage over Nd:YAG in large systems because of its high efficiency and availability in large sizes. In small rod systems, though, the larger thermal lensing and birefringence in Nd:Cr:GSGG make it less desirable than Nd:YAG from an optical standpoint, but its high efficiency means that laser system size and weight can be reduced. Progress in obtaining large Nd:Cr:GSGG slabs is reviewed. In this effort, Allied-Signal Corp. has successfully grown 5-inch diameter Nd:Cr:GSGG boules. 22 refs.

39412 **(UCRL—96329) Optical guiding and beam bending in free-electron lasers.** Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 41p. (CONF-870132—8). NTIS, PC A03/MF A01; GPO Dep. File Number DE87010814.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The electron beam in a free-electron laser (FEL) can act as an optical fiber, guiding or bending the optical beam. The refractive and gain effects of the bunched electron beam can compensate for diffraction, making possible wigglers that are many Rayleigh ranges (i.e., characteristic diffraction lengths) long. The origin of optical guiding can be understood by examining gain and refractive guiding in a fiber with a complex index of refraction, providing a mathematical description applicable also to the FEL, with some extensions. In the exponential gain regime of the FEL, the electron equations of motion must be included, but a self-consistent description of exponential gain with diffraction fully included becomes possible. The origin of the effective index of refraction of an FEL is illustrated with a simple example of bunched, radiating dipoles. Some of the properties of the index of refraction are described. The limited experimental evidence for optical beam bending is summarized. The evidence does not yet provide conclusive proof of the existence of optical guiding, but supports the idea. Finally, the importance of refractive guiding for the performance of a high-gain tapered-wiggler FEL amplifier is illustrated with numerical simulations.

39413 **Rare-gas-halide laser performance by the use of two halogen donors.** Chantry, P.J.; Denes, L.J.; Kline, L.E. (to Secretary of the Army, Washington, DC). US Patent 4,670,883. 2 Jun 1987. Filed date 3 Jun 1985. vp.

A method is described of operating a self-sustained discharge pumped rare gas-halide laser employing a rare gas selected from the group consisting of helium, neon, argon, krypton, xenon, and radon. A single strongly attaching halogen donor, XHn functions in the discharge and laser kinetics to simultaneously affect laser performance in achieving high energy deposition at low concentration values of XHn and high excited rare gas-halide production efficiency at high concentration values of XH/sub n/.

39414 **Semiconductor alloy lasers - 1962.** Holonyak, N. Jr. (Electrical Engineering Research Lab., Center for Compound Semiconductor Microelectronics, and the Materials Research Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-23**: No. 6, 684-691(Jun 1987).

Following the report of high-efficiency generation and transmission of recombination radiation from Zn-diffused GaAs p-n junctions at the 1962 IRE Solid State Device Research Conference (July, Durham, NH), a many-laboratory race began to construct a semiconductor laser. Although it is widely believed that only GaAs was involved in the research that led to a semiconductor laser, the visible-spectrum alloy GaAs/sub 1-x/P/sub x/ was in the middle of

this activity and was (fall of 1962), with GaAs, a first semiconductor laser, not to mention the first laser in a semiconductor alloy or crystal that could be "tuned" in energy gap (and wavelength) from direct-gap to indirect gap. The ternary GaAs/sub 1-x/P/sub x/ was the forerunner of all present-day III-V alloys used in heterojunction devices. The sequence of events leading up to the GaAs/sub 1-x/P/sub x/ laser, as well as its introduction in modified form as the first practical LED, are described.

39415 **Free-running modes for gain-guided diode laser arrays.** Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (Sandia National Labs., Albuquerque, NM). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-23**: No. 6, 765-774(Jun 1987). Contract AC04-76DP00789.

The authors present a numerical model for directly calculating the eigenmodes of multiple-stripe gain-guided diode laser arrays, which includes the effects of both carrier diffusion and heating in the active region. Comprehensive calculations of the eigenmodes of a CW gain-guided array using this model are directly compared to experimental observations on commercial ten-stripe arrays. These numerical and experimental results show that, contrary to popular wisdom, gain-guided arrays are characterized by a large number of eigenmodes, not limited to the number of elements in the array. In addition, the results show the importance of including the refractive index perturbation arising from junction heating, which dramatically alters both the character and the gain of the array modes.

39416 **CRC handbook of laser science and technology. Volume 5. Optical materials. Part 3. Applications, coatings, and fabrication.** Weber, M.J. Boca Raton, FL; CRC Press Inc. (1987). 544p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book describes the uses, coatings, and fabrication of laser materials. Topics considered include: optical waveguide materials; optical storage materials; holographic recording materials; phase conjunction materials; holographic recording materials; phase conjunction materials; laser crystals; laser glasses; quantum counter materials; thin films and coatings; multilayer dielectric coatings; graded-index surfaces and films; optical materials fabrication; fabrication techniques; fabrication procedures for specific materials.

39417 **CW dye laser with a photorefractive intracavity mode selector and frequency stabilizer.** Whitten, W.B.; Ramsey, J.M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831-6142). pp WA2.1-WA2.2 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—). Contract AC05-84OR21400.

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The authors have recently performed some experiments with a standing-wave CW dye laser with a BaTiO/sub 3/ crystal intracavity element. A holographic grating formed within the crystal by the counterpropagating waves in the laser cavity generates positive feedback that is strongly frequency selective. The laser has a narrow linewidth with unusual mode patterns that depend upon the position of the crystal along the cavity axis. The output frequency is unstable for most positions of the crystal but is exceptionally stable for a few regions. With the crystal at one of these locations, it is possible to scan the output frequency at high resolution over a range of several hundred wavenumbers without mode jumps. The frequency stability and scanning is interpreted in terms of static and dynamic phase shifts between the light that produces the holographic grating in the BaTiO/sub 3/ crystal and the light reflected by the grating. The mode selection is due to a combination of mode competition in the gain medium and the variation of grating contrast with the different patterns of oscillating modes. Stable mode patterns that are observed include doublets and triplets with spacings of 1.5 GHz, the spacing permitted by mode competition in the dye. Both narrower and wider separations are observed at other crystal positions. At 1.6 cm from the front mirror, a very narrow doublet is observed, with the two frequencies becoming degenerate for a cavity length of 51 cm. The laser linewidth is less than 30 MHz under these conditions.

39418 **CRC handbook of laser science and technology. Volume 4. Optical materials, Part 2 - Properties.** Weber, M.J. Boca Raton, FL; CRC Press Inc. (1986). 496p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book examines the optical properties of laser materials. Topics considered include: fundamental properties; transmitting materials; crystals; glasses; plastics; filter materials; mirror and reflector materials; polarizer materials; special properties; linear electrooptic materials; magnetooptic materials; elastooptic materials; photorefractive materials; and liquid crystals.

39419 **CRC handbook of laser science and technology. Volume 3. Optical materials, Part 1 - Nonlinear optical properties/radiation damage.** Weber, M.J. Boca Raton, FL; CRC Press Inc. (1986). 480p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book examines the nonlinear optical properties of laser materials. The physical radiation effects on laser materials are also considered. Topics considered include: nonlinear optical properties; nonlinear and harmonic generation materials; two-photon absorption; nonlinear refractive index; stimulated Raman scattering; radiation damage; crystals; and glasses.

39420 **CRC handbook of laser science and technology. Volume 3. Gas lasers.** Weber, M.J. Boca Raton, FL; CRC Press Inc. (1982). 584p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book describes the fundamentals of gas lasers. It provides information and data on neutral gas lasers, ionized gas lasers, and molecular gas lasers. Concluding this volume is an extensive table of all gas laser wavelengths.

39421 **CRC handbook of laser science and technology. Volume 1. Lasers and masers.** Weber, M.J. Boca Raton, FL; CRC Press Inc. (1982). 568p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book describes various types of lasers and masers. The following topics are discussed in detail: types and comparisons of laser sources, crystal and glass lasers, semiconductor lasers, organic dye and other liquid lasers, free-electron and x-ray lasers, masers and laser safety.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 38463, 38815, 38816, 38840, 38858, 38920, 38996, 39160, 39318

39422 (AGARD-CP—99, pp vp) **Laser fringe anemometry for aero engine components.** Strazisar, A.J. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Advances in flow measurement techniques in turbomachinery continue to be paced by the need to obtain detailed data for use in validating numerical predictions of the flowfield and for use in the development of empirical models for those flow features which cannot be readily modelled numerically. The use of laser anemometry in turbomachinery research has grown over the last 14 years in response to these needs. Based on past applications and current developments, the key issues which are involved when considering the application of laser anemometry to the measurement of turbomachinery flowfields are discussed. Aspects of laser fringe anemometer optical design which are applicable to turbomachinery research are briefly reviewed. Application problems which are common to both laser fringe anemometry (LFA) and laser transit anemometry (LTA) such as seed particle injection, optical access to the flowfield, and measurement of rotor rotational position are covered. The efficiency of various data acquisition schemes is analyzed and issues related to data integrity and error estimation are addressed. Real-time data analysis techniques aimed at capturing flow physics in real time are discussed. Finally, data reduction and analysis techniques are discussed and illustrated using examples taken from several LFA turbomachinery applications.

39423 (AGARD-CP—99, pp vp) **Digital image processing applied to fluid dynamic problems.** Buchlin, J.M. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Applications of visualization techniques associated with Digital Image Processing in fluid dynamics are discussed. Two typical fluid flow problems of interest for propulsion are selected to illustrate the purpose. The mixing properties of the jet are discussed. Laser tomography and light scattering from micro-droplets of oil lead to the quantification of the three dimensional concentration field. The local heat transfer distribution on a heated surface from oblique and co-liner impinging jets is discussed. Thermographic imaging system is used. Digitized infrared pictures are processed to provide local and average values of the heat transfer coefficients.

39424 (AGARD-CP—99, pp vp) **Beam-modulation methods in quantitative and flow-visualization holographic interferometry.** Decker, A.J. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Heterodyne holographic interferometry and time-average holography with a frequency shifted reference beam are discussed. Both methods will be used for the measurement and visualization of internal transonic flows where the target facility is a flutter cascade. The background and experimental requirements for both methods are reviewed. Measurements using heterodyne holographic interferometry are presented. The performance of the laser required for time-average holography of time-varying transonic flows is discussed.

39425 **(Juel—2106) Calculation of heat transfer in the region of separated flow downstream of a sudden expansion.** Achenbach, E.; Froning, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Dec 1986. 58p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08678.

Forced convective heat transfer from a two-dimensional channel with a sudden expansion on one side is computed. For this reason the vorticity equation and the energy equation as well must be solved. The numerical method applied is the Crank-Nicolson procedure. The influence of the Reynolds number ($10<Re<2000$) and of the Prandtl-number ($0,7<Pr<2,5$) on the flow and heat transfer is considered. With increasing Reynolds number the length of the recirculation zone grows up levelling out to 11/12 step heights for $Re>1000$. The effect of the Prandtl-number on heat transfer can be approximated by the function Pr/sup 1/3/. The theoretical results agree well with those from other authors and from own experiments. The two methods applied to solving the equations of motion show that the implicite procedure is more appropriate for calculations at high Reynolds-numbers. Nevertheless, this advantage is associated with an increase of computing time by about 25%.

39426 **(N—87-21141) Microgravity fluid management symposium.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 225p. (NASA-CP—2465; E—3386; NAS—1.55:2465; CONF-8609146—). NTIS, PC A10/MF A01.

From Microgravity fluid management symposium; Cleveland, OH, USA (9 Sep 1986).

The NASA Microgravity Fluid Management Symposium, held at the NASA Lewis Research Center, September 9 to 10, 1986, focused on future research in the microgravity fluid management field. The symposium allowed researchers and managers to review space applications that require fluid management technology, to present the current status of technology development, and to identify the technology developments required for future missions. The 19 papers covered three major categories: (1) fluid storage, acquisition, and transfer; (2) fluid management applications, i.e., space power and thermal management systems, and environmental control and life support systems; (3) project activities and insights including two descriptions of previous flight experiments and a summary of typical activities required during development of a shuttle flight experiment.

39427 **(NP—7752234) Experimental and theoretical investigation of flow processes in return ducts of radial compressor stages, particularly those of low duct width.** Gallus, H.E.; Rothstein, E. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Strahlantriebe und Turboarbeitsmaschinen). Apr 1985. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752234.

The purpose of this work is the investigation and improvement of feedback ducts with blades in multistage radial compressors. The main point lies in feedback in stages with small flow parameters. The boundary conditions of the radial compressor stage are examined first. The configuration of the feedback ducts and blades is then discussed. Designs and the construction of the measuring for examining feedback are also discussed. Finally, the results of feedback experiments are discussed and summarized. (HAG).

39428 **(NP—7770161) Experimental investigation of dependence of the spacing of two successive ring vortices on the gas flow and on the loudspeaker noise in a free jet burning from a rectangular slot.** Schneider, P.E.M. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Mar 1982. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770161.

The author examines the spacing of two successive turbulent ring vortices in a burning free jet affected by sound. The vortex structure of non-burning and burning jets, which flow through nozzles with differently shaped crossections, is examined. The behaviour of individual ring vortices with circular and elliptical closed vortex axes is also observed. The shapes of free water jets, which flow vertically upwards into the air through a rectangular slot and the shapes of free jets which burn on rectangular slots are also determined. Apparatus, methods of measurement and the evaluation are also described and the results are summarized and discussed. (HAG).

39429 **(NP—7770251) Numerical calculation of typical single-phase and two-phase flow in combustion chambers.** Noll, B.E. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). 16 Dec 1985. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770251.

The development costs of combustion chambers for big, stationary gas turbine and high-performance turbo-engines working at high pressures and temperatures can be reduced considerably by theoretical flow optimisation. The author extends a numerical method for calculating three-dimensional turbulent and recirculating flow and assesses the accuracy of this method in calculating typical flow patterns in combustion chambers. The numerical method, the flow in the mixing zone and primary zone of the combustion chamber, and the diffusion of fuel droplets are presented and investigated. (HAG).

39430 **(SAND—86-2875C) The aerothermodynamic environment for holes in hypersonic configurations.** Bertin, J.J.; Tedeschi, W.J.; Bustamante, A.C.; Reece, E.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870830—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003790.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

Results that are presented in this paper were generated in a study that focused on determining the aerothermodynamic environment that results when the external flow over a configuration in a hypersonic stream encounters a hole in its surface. A numerical code has been developed to compute a two-dimensional, expanding shear layer and the inviscid/viscid interaction that occurs at the recompression face at the downstream end of the hole. Surface pressures and heating rates were measured in a wind tunnel test and compared to the computed values using this new technique. The results of these comparisons are satisfactory.

39431 **(TUM-LSM—84/29) Numerical calculation of turbulent recirculating flows.** Werner, H. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Stroemungsmechanik). 1984. 146p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770160.

In the context of this work, different discretisation processes for the differential formulation of a general transport equation are critically compared and their accuracy of approximation is checked using a onedimensional test problem which can be solved analytically. The main point of this work is the expansion of the STAR program by a turbulence model, which, in addition to the pulse equations, requires the solving of two transport equations for the turbulence energy k and the dissipation ϵ and is therefore called the K-ϵ model. The description of the turbulence structure on the k-ϵ model is done by a length dimension (proportional to k/sup 3/2//ϵ) and a speed dimension (proportional to k/sup 1/2/). In order to solve the system of five connected differential equations, all the discretisation processes can be used, with one exception. The formulation of the boundary conditions for laminar and particularly for turbulent flow is dealt with in detail. The tubulent flow in a cavity with a moving cover plate, over a step jumping back and over a fin, are used as test examples. The laminar case is also examined for the cavity and for the step. Experimental data are used to assess the results, in the first place, and if these are not available (cavity), the numerical calculations by other authors which are available in the literature.

39432 **(UCRL—96078) Multiphase flow in geological materials: Dynamic loading theory and numerical modelling.** Kansa, E.J.; Kirk, T.M.; Swift, R.P. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 29p. (CONF-870816—10). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005922.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

A numerical scheme has been developed for integrating the time-dependent conservation equations for multifluid porous flow. One of its features is an explicit-implicit method for integrating the constituent momentum equations which only involves a block diagonal matrix. The equations are solved in a Lagrangian frame tied to the solid particle velocity. In this frame, it is possible to time-integrate the liquid and gaseous mass conservations exactly. The solution technique has been demonstrated on a 2- and 3-phase porous flow shock tube simulation. The saturated case agrees well with previous results. The unsaturated case has been investigated. The gas phase response, because of small inertia, is basically uncoupled from that of the solid and liquid. The unsaturated case also permits gas, "air", to be transported in or out of pores very readily as compared to water which has more inertia.

39433 **An adaptive finite element method for steady and transient problems.** Benner, R.E. Jr.; Davis, H.T.; Scriven, L.E. (Sandia National Labs., Div. 1413, Albuquerque, NM). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 4, 529-549(Jul 1987).

Distributing integral error uniformly over variable subdomains, or finite elements, is an attractive criterion by which to subdivide a domain for the Galerkin/finite element method when localized steep gradients and high curvatures are to be resolved. Examples are fluid interfaces, shock fronts and other internal layers, as well as fluid mechanical and other boundary layers, e.g. thin-film states at solid walls. The uniform distribution criterion is developed into an adaptive technique for one-dimensional problems. Nodal positions can be updated simultaneously with nodal values during Newton iteration, but it is usually better to adopt nearly optimal nodal positions during Newton iteration upon nodal values. Three illustrative problems are solved: steady convection with diffusion, gradient theory of fluid wetting on a solid surface and Buckley-Leverett theory of two phase Darcy flow in porous media.

39434 **Heat, mass, and momentum transport model for hydrogen diffusion flames in nuclear reactor containments.** Travis, J.R. (Los Alamos National Lab., NM). *Nuclear Engineering and Design;* **101**: No. 2, 149-166(May 1987). (CONF-850810—).

From 23. national heat transfer conference; Denver, CO, USA (4 Aug 1985).

It is now possible to analyze the time-dependent, fully three-dimensional behavior of hydrogen combustion in nuclear reactor containments. This analysis involves coupling the full Navier-Stokes equations with multi-species transport to the global chemical kinetics of hydrogen combustion. A transport equation for the subgrid scale turbulent transport kinetic energy density is solved to produce the time and space dependent turbulent coefficients. The heat transfer coefficient governing the exchange of heat between fluid computational cells adjacent to wall cells is calculated by a modified Reynolds analogy formulation. The analysis of a Mark-III containment indicates very complex flow patterns that greatly influence fluid and wall temperatures and heat fluxes.

39435 **Benchmarking the Q/TRAN thermal-analysis computer code.** Manteufel, R.D.; Klein, D.E.; Yoshimura, H.R. (Texas Univ., Austin; Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Q/TRAN, a new thermal analysis computer code, was examined for its use in modelling the responses of radioactive material shipping casks under accident conditions. A comparison between Q/TRAN and HEATING-6 was made using four benchmark problems chosen for their cask-like geometries and similarity to packaging thermal environments. HEATING-6 was chosen for comparison because HEATING-5, a predecessor to HEATING-6, was used in previous cask analyses. Modelling capabilities for each code are discussed as they relate to the four benchmark model problems. Q/TRAN was determined to be advantageous because of (1) its superior numerical algorithms and (2) the pre- and postprocessing capabilities (with PATRAN) that allow the graphical display of flexible meshing schemes and thermal results. Poster presentation. 6 figures, 4 tables.

39436 **Numerical technique for the solution of a vaporizing fuel droplet.** Patnaik, G.; Sirignano, W.A.; Dwyer, H.A.; Sanders, B.R. pp 253-266 of Dynamics of reactive systems; International Colloquium on Dynamics of Explosions and Reactive Systems, 10th, Berkeley, CA, Aug. 4-9, 1985, Technical Papers. Part 2 - Modeling and heterogeneous combustion. Volume 105. Bowen, J.R.; Leyer, J.C.; Soloukhin, R.I. New York, NY; American Institute of Aeronautics and Astronautics, Inc. (1986). (CONF-850830—).

From 10. international colloquium on dynamics of explosions and reactive systems; Berkeley, CA, USA (4 Aug 1985).

A technique suitable for investigating fuel droplet vaporization in a hot gas stream is described. The solution technique utilizes a second-order, transient finite-difference code in primitive variables to handle variable density, two-phase flows. The technique has been applied to several cases of single-droplet vaporization in a convecting environment, and a detailed picture of the transport processes throughout the droplet lifetime is presented. Due to drag, the dominance of convection on transport processes gives way to diffusion. Most earlier models assumed the dominance of one mode or the other. 19 references.

4205 Materials Testing

REFER ALSO TO CITATION(S) 38833, 39191, 39192, 39503, 39536

39437 **(BDX—613-3700) Characterization of defects in Mn-Zn ferrites by scanning laser acoustic microscopy (SLAM).** Boehning, C.W.; Tuohig, W.D. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jun 1987. Contract AC04-76DP00613. 13p. (CONF-8706116—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010677.

From 16. international symposium on acoustic imaging; Chicago, IL, USA (10 Jun 1987).

A scanning laser acoustic microscope (SLAM) has been used to evaluate the integrity of Mn-Zn ferrite ceramic components which comprise part of the magnetic circuit in an electromechanical code interrogation device. Cracking of the ferrites during processing and assembly emerged as a significant manufacturing problem. Operations such as grinding, metallization, joining, and welding were suspected of causing damage, and acoustic microscopy was used to monitor these processes. Parts which produced suspicious acoustic images were dismantled and destructively sectioned to identify specific physical defects. Correlations between the defects and their acoustic signatures were established. This procedure has provided the basis for several process modifications and improvements which have resulted in acceptable production yields. The SLAM is used as an engineering tool for the detection and characterization of defects and is presently being used routinely to inspect production ferrite components.

39438 **(BNL—39816) Comparison of Wyko and TIS measurements of surface finish.** Church, E.L.; Sanger, G.M.; Takacs, P.Z. (Picatinny Arsenal, Dover, NJ (USA); United Technologies Research, Arlington, VA (USA); Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-870132—9). NTIS, PC A02. File Number DE87010757.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

Profile and area measurements of the roughness of a given surface will generally be different since the two measurement techniques are sensitive to different areas of surface-frequency space. This paper explores the magnitudes of these differences by calculating the ratio of rms roughness values, σ (TIS)/σ(Wyko), using strawman models of a Wyko profiling microscope and a Talandic integrating scatterometer applied to surfaces having different roughness power spectra. As expected, the results show that this ratio can vary widely about unity, with values depending on the magnification of the objective used in the Wyko microscope and the "color" of the surface spectrum. An amazing counter example appears to occur for surfaces having an approximately "$1/\theta^2$" BRDF, or equivalently, a 1/f profile power spectrum - shapes which are frequently observed for non-metallic mirror surfaces. In this case the predicted TIS and Wyko roughness values are essentially identical and independent of the Wyko magnification. This equality, however, comes from a curious mathematical-numerical coincidence and does not mean that these apparently "universal" values represent any intrinsic finish parameters of the surface being measured. In fact, if the Wyko data are filtered to remove the contributions from surface wavelengths longer than those included in the TIS measurements in order to more nearly match the instrumental bandwidths, the calculated ratio of measured rms roughness values increases to 1.5 to 5, depending on the Wyko parameters used. These results illustrate the fact that any realistic comparison of profile and area measurements of surface finish requires a knowledge of both the instrumental transfer functions and the form of the power spectrum of the surface being measured. The present paper discusses these issues and provides analytic machinery for the detailed quantitative comparison of profile, TIS and BRDF measurements.

39439 **(CONF-8610299—1-Ext.-Abst.) Development of advanced nondestructive evaluation methods for ceramic processing reliability.** Ellingson, W.A.; Ackerman, J.L.; Sawicka, B.D.; Roberts, R.A.; Poeppel, R.B. (Argonne National Lab., IL (USA); Massachusetts General Hospital, Boston (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012216.

From Processing for reliability of advanced ceramics; Corning, NY, USA (21 Oct 1986).

Functional failure of parts or components fabricated from ceramics is most often traced to defects (e.g., inclusions, undesirable density gradients, cracks, poor binder/plasticizer distributions, etc.) introduced in the early processing steps. Detection of these defects, especially in the green state, and elimination of the source of these defects will improve the economics as well as the reliability of advanced ceramics.

39440 **(DPST—87-437) Acoustic emission monitoring of pinch welds.** Kain, K.E.; Lawson, R.R. (Savannah River Lab., Aiken, SC (USA)). May 1987. Contract AC09-76SR00001. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011245.

Acoustic emission (AE) response during welding was examined as a possible nondestructive tool to evaluate weld quality. Welding was performed with varying current, gas atmosphere, stem restraint, and surface oxide thickness. The welds were examined for peel strength, fracture surface appearance, and metallurgical bond quality. Acoustic emission monitoring and analysis was performed by the Physical Acoustics Corporation (PAC). Results show that the AE welding function (AEWF) as defined by PAC is a good measure of bond strength for normal stems welded in a hydrogen atmosphere. The AEWF increases as the weld strength and bond quality increase. The AE analysis gave significant information regarding welding mechanisms. Plastic deformation, associated with a low AEWF, occurs at low currents and at the beginning of the weld period. At higher currents, recrystallization and grain growth occur across the bond interface, resulting in good strength and medium AEWF values. For fully restrained stems, melting and solidification processes are observed to greatly increase the bond strength and AE response.

39441 **(NP—7770247) Investigation of two-dimensional elasto-dynamic stress concentration and crack problems.** Kraft, W.W. (Kaiserslautern Univ. (Germany, F.R.). Fachbereich Maschinenwesen). 23 Jan 1986. 155p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770247.

The author is concerned with the analysis of two-dimensional elasto-dynamic stress concentration problems, which can occur in parts of buildings and machines. The finite element programme system 'ELADYN' was developed for this purpose, which is designed so that it can work with a very limited core storage capacity. A further process is developed and introduced for solving systems of differential equations. Fracture dynamics analyses are carried out using two processors based on integral independent of movement, and a system of equations which are overdetermined. The suitability of fracture dynamics processors is also determined and applicability of the 'ELADYN' programme system is shown by the treatment of notches and inclusions in dynamically loaded discs, and by elasto-dynamic notch crack problems. (HAG).

39442 **(SAND—83-2145) Finite element analysis of a bimaterial interface crack.** Chen, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1983. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012828.

In this investigation, the enriched element method developed by Benzley was extended to treat the stress analysis problem involving a bimaterial interface crack. Unlike crack problems in isotropic elasticity, where the stress singularity at the crack tip is of the inverse square root type, the interface crack contains an additional oscillatory singularity. Although the effect of this oscillatory characteristic is confined to a region very close to the crack tip, it nevertheless requires proper treatment in order to obtain accurate predictions on the stress intensity factors. Using appropriate crack tip stress and displacement expressions, the enriched element method can model the stress singularity for an interface crack exactly. The finite element implementation of this method has been made on the code APES. Stress intensity factor results predicted by the modified APEs program compare favorably with those available in the literature. This indicates that the enriched element technique provides an accurate and efficient numerical tool for the analysis of bimaterial interface crack problems. 13 refs., 4 figs., 3 tabs.

39443 **Development of a large unyielding target for packaging tests.** Allen, G.C. Jr.; Gonzales, A.; Pierce, J.D.; Bruneske, J.D. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

A large, essentially unyielding, target for nuclear transportation package testing was developed at Sandia National Laboratories in Albuquerque, New Mexico. The target was designed, and its performance predicted, using computer-modeling methods. The performance was verified by conducting a high-speed impact test of an experimental package onto the target and analysing data from instrumentation installed within the target. Poster presentation. 4 references, 5 figures, 1 table.

39444 **High-temperature testing of structurally damaged impact and puncture-package-protection systems.** Hudson, M.L.; Moya, J.L. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Heat transfer through materials that change phase or combust is a complex process. It is important to understand the heat transfer in such materials in order to analyse and predict the survivability of a nuclear-material-transportation package in a hypothetical thermal accident. Therefore, several high-temperature tests were conducted to study the behavior of some common materials used in such nuclear material transportation packages. Poster presentation. 7 references, 4 figures.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 39276, 39538

39445 **(BNL—39708) Gigabit chips: A case history of a transfer of federal technology.** Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-8706111—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010368.

From 12. annual meeting and international symposium of the Technology Transfer Society; Washington, DC, USA (22 Jun 1987).

This report discusses the need for industry/government cooperation in developing new semiconductor technology. In order to increase memory density of chips from 1M bit, it is necessary to use a process other than optical lithography for production. The technique considered here is x-ray lithography. Industry is currently found to be unwilling or unable to finance research into this technology. If US industry is to remain competitive in the world semiconductor market, it is concluded that the government must cooperate and support work in this area. 16 refs. (JDH)

39446 **(SAND—86-1555) Development and process control for rigid/flex, multilayer printed wiring boards.** Gentry, F.L. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012845.

Rigid/flex multilayers require certain unique processing parameters not common to conventional printed wiring products: special machining of windows, the use of no-flow prepreg adhesives, plasma etching of nonhomogeneous material compositions, and more stringent plating controls. Performance of these products can be predicted by modeling studies and verified by physical testing. Thermophysical characteristics are described as well as the establishment of rigid/flex capabilities in a development laboratory. The actual fabrication processing steps are also described for high-reliability, six-layer rigid/flex boards whose two center layers are flexible circuitry.

39447 **(SLAC-PUB—3890-Rev.) The microlasertron: An efficient switched-power source of mm wavelength radiation.** Palmer, R.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Brookhaven National Lab., Upton, NY (USA)). Dec 1986. Contract AC03-76SF00515. 12p. (CONF-8608123—11-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010539.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

An extension of W. Willis' "Switched Power Linac" is studied. Pulsed laser light falls on a photocathode wire, or wires, within a simple resonant structure. The resulting pulsed electron current between the wire and the structure wall drives the resonant field, and rf energy is extracted in the mm to cm wavelength range. Various geometries are presented, including one consisting of a simple array of parallel wires over a plane conductor. Results from a one-dimensional simulation are presented.

39448 **(UCRL—15904) 140 GHz gyrotron development program: Quarterly report No. 9, April through June 1986.** Felch, K.L.; Bier, R.E.; Craig, L.J.; Ives, R.L.; Jory, H.R.; Lopez, N.C.; Neilson, J.M.; Spang, S.T.; Stockwell, B.C. (Varian Associates, Inc., Palo Alto, CA (USA); Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010875.

The objective of this program is to develop a gyrotron oscillator capable of producing 100 kW CW at 140 GHz. Several sets of calculations are described characterizing the TE_{021}/TE_{031} complex cavity used on Preprototype Tube 1. Initial design calculations for a new complex cavity design for Preprototype Tube 2 are summarized. Several analyses of the output window design were performed to improve agreement between calculated and meaured temperature data and to investigate the behavior of the window design at higher power levels. The results of these analyses are reported. Long-pulse and CW tests on Preprototype Tube 1 were carried out. During these tests, a CW power level of 100 kW was obtained, thus meeting the major technical goal of the 140 GHz Gyrotron Development Program. Long-pulse tests resulted in the achievement of a power level of 150 kW during 100 ms pulse operation. Additional short-pulse tests yielded power levels in excess of 200 kW. The results of the various tube tests on Preprototype Tube 1 are described and compared to theoretical predictions where possible. Initial tube tests on the rebuild of Experimental Tube 1 are summarized.

39449 **(UCRL—15914) HF shipboard antennas: Final report.** Rudduck, R.C.; Caldecott, R. (Ohio State Univ., Columbus (USA). Electroscience Lab.). Mar 1987. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010948.

The purpose of this research is to determine the most promising antenna types for shipboard applications in the 0.1 to 30 MHz frequency range with emphasis on survivability. The scope of this research is (1) Survey and review all known HF antenna concepts; and (2) Perform preliminary assessments of the various HF antenna concepts; and recommend and prioritize the most promising candidates. 11 refs.

39450 **(UCRL—52000-87-4) Energy and Technology Review, April 1987.** Lear, R.D.; Balch, J.W.; Crawford, R.B.; de Vore, L.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010551.

A short review of five current research projects at Lawrence Livermore National Laboratory is given. New techniques in microfabrication allow the study of new phenomena and the collection of better diagnostic data. High speed gallium arsenide devises and integrated circuits are being fabricated that can measure transient waveforms at a 5 GHz sampling rate. Wide band, integrated optical modulators for the remote measurement of high speed transient signals are being developed. Extensive research on unique high speed high voltage semiconductor devices for detectors and

switching applications is being developed. Finally, it has become possible to design and fabricate semicustom, special purpose integrated circuits in less than five weeks. 6 refs., 42 figs., 4 tabs.

39451 (UCRL—93928) Waveguide electro-optic modulators for high speed diagnostics. McWright, G.M.; Jander, D.R.; Koo, J.C.; Kwiat, P.; Lowry, M.E.; Roeske, F. Jr.; Slivinsky, V.W. (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 10p. (CONF-860117—19). NTIS, PC A02. File Number DE87009604.

From Los Angeles symposium and exhibition on optical and electro-optical engineering; Los Angeles, CA, USA (19 Jan 1986).

The design, fabrication, and testing of a high speed traveling wave directional coupler modulator for a guide wavelength of 810 nm is described. Application to high speed diagnostic systems is discussed.

39452 Mode conversion in a cylindrical waveguide with periodic step changes in the radius. Schill R.A. Jr.; Seshadri, S.R. (Department of Electrical Engineering and Computer Science, University of Illinois at Chicago, Chicago, Illinois 60680). *Journal of Applied Physics;* **62**: No. 6, 2178-2186(15 Sep 1987).

For the transverse electric modes having azimuthal variation in a cylindrical waveguide with periodic step changes in the radius, the propagation of the modal voltages and currents is investigated. The transfer coefficients are deduced and their values are explicitly determined for small relative changes in the radius. The theory is applied to treat a mode converter in which there is a selective interaction between two forward traveling modes, and the theoretical results are compared with available experimental observations.

39453 Gigawatt-level microwave bursts from a new type of virtual cathode oscillator. Davis, H.A.; Bartsch, R.R.; Kwan, T.J.T.; Sherwood, E.G.; Stringfield, R.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 3, 288-291(20 Jul 1987).

We describe experiments that demonstrate a new method for producing high-power microwave emission. The unstable oscillations of a virtual cathode which forms when a magnetized relativistic electron beam is injected into a circular waveguide generate the microwave radiation. In contrast to previous virtual cathode microwave generation techniques, electrons in the waveguide cannot be reflected back into the diode. Using this technique, we have produced 1.4 GW at 3.9 GHz with several hundred megawatts radiated in harmonic radiation.

39454 Light emission from metal-insulator-metal structures biased near breakdown voltages. Bloemer, M.J.; Goudonnet, J.P.; James, D.R.; Warmack, R.J.; Ferrell, T.L.; Arakawa, E.T.; Callcott, T.A. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 335-338 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—). Contract AC05-84OR21400.

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

Optical emission is observed at pre-breakdown voltages in thin film metal-insulator-metal (MIM) structures. Subsequent examination of the junction in a scanning electron microscope (SEM) reveals filamentary growth through the insulator. These tunnel junctions consist of Al-Al/sub 2/O/sub 3/-Ag or Al-Al/sub 2/O/sub 3/-Au with a variety of microstructures incorporated in the junction. The emission spectrum is found to be dependent on the geometry of the MIM structure. Comparison of theory and experiment suggests the emission results from the radiative decay of collective electronic excitations (surface plasmons) initiated by electrons tunneling through the insulator.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 38715, 39570

39455 (ORNL/TM—10471) Catalytic sodium hypochlorite degradation using a Kynar stabilized catalyst. Compere, A.L.; Griffith, W.L. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 28p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012520.

Based on bench scale data, the Kynar-cobalt oxide catalyst developed by Pennwalt is able to treat waste hypochlorite streams. The effectiveness of the catalyst rises with decreasing pH and increasing temperature. At 55 to 70°C, it is possible to meet discharge requirements using a single pass through an upflow 40 cm deep catalyst bed. Solution pH will be reduced somewhat. The size of a Pennwalt unit for a given flow/concentration can be estimated. Based on bench experience, construction and operation of a full scale unit appears economically feasible. Operating problems with the system include attrition, catalyst conditioning and storage. Catalyst attrition is a major problem. In bench tests, catalyst loss from a tared laboratory column across several weeks was about 0.5 gram per gallon of concentrated hypochlorite processed or, using current Pennwalt costs of $50/lb catalyst, $55 per 1000 gal. Attrition may result from explosion of the catalyst by trapped oxygen. Several operating parameters can increase the rate of catalyst breakdown: high hypochlorite concentrations, increased temperature, and decreased pH. Once attrition begins, increased catalyst movement increases breakdown due to mechanical abrasion. Operations methods can be planned to decrease catalyst breakup by limiting the rate of hypochlorite degradation. Alternatively, a lower efficiency catalyst could be formulated. However, easy catalyst reloading should be part of any equipment design. During first use, a gradual increase in hypochlorite concentrations for several hours appears necessary. In re-uses of the bed after storage, at least a half hour of use is required for consistent minimal hypochlorite output. During startup periods, provision for effluent recycle is recommended. Wet storage of catalyst is recommended by previous investigators.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 38548, 38682, 38717, 38718, 38785, 39157, 39340, 39341, 39428, 39429, 39570

39456 (AGARD-CP—99, pp vp) CARS thermometry for low and high pressure combustion systems. Greenhalgh, D.A. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The theory and application of broadband Coherent Anti-Styles Raman Spectroscopy (CARS) for ambient (low) and high pressure combustion thermometry is discussed. The accuracy of broadband CARS is assessed from 300 to 3500 Kelvin for pressures around 1 bar, and from 300 to 700 Kelvin for pressures from 1 to 20 bar. The use of CARS thermometry for both average and instantaneous measurements is discussed. Systematic accuracy strongly depends on the quality of the spectral model used in the CARS data analysis step. CARS spectral modelling methods are discussed with particular reference to important recent developments. Instantaneous CARS accuracy is importantly influenced by noise arising in both the broadband dye laser and the multichannel detector. Both of these factors, and their relative influences are assessed. The application of CARS thermometry is illustrated by application to both in-cylinder studies of an operating production i.c. petrol engine and to turbulent combustion in an oil-fired 30 kilowatt furnace.

39457 (AGARD-CP—99, pp vp) Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor. Williams, M.C. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The measurement of airflow through multi-stage compressor rigs has generally been limited to the use of flow perturbing pressure and temperature probes. Although limited studies of the dynamics of these flows have been obtained with hot wire and hot film probes, the advent of the laser Doppler velocimeter (LDV) with its non-perturbing nature is expected to develop into the preferred instrumental method. To assess the feasibility of utilizing an LDV in these flows an exploratory program was recently undertaken at Pratt and Whitney. A multi-stage compressor rig, the Energy Efficient Engine high pressure compressor consisting of 6th through 15th compressor stages, was outfitted with windows between the 6th stator-7th rotor, 9th stator-10th rotor, and 13th stator-14th rotor. The windows, extending circumferentially one stator gap wide, permitted the hub to tip traversing midway between the stator trailing edge and the rotor leading edge both in and out of the stator wakes. A confocal two color, two component back scatter LDV system developed for use in gas turbine environs was employed to obtain detailed mappings to velocity magnitude and air angle as a function of rotor position at several spanwise and gapwise positions downstream of the 6th and 9th compressor stators. Although a complete mapping was not obtained, sufficient data was acquired behind the 13th stator to identify the flow's character there as well. The equipment employed in this study and the difficulties encountered are described.

39458 (AGARD-CP—99, pp vp) **Sapphire fiber optic temperature probe.** Tichenor, D.A.; Hencken, K.R.; Bickes, R.W. Jr. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

A sapphire fiber optic pyrometer was developed for use in combustion environments. Two configurations of the device are described. One is designed to measure rapid gas temperature fluctuations and the other is designed to measure the rapid temperature rise in a confined pyrotechnic prior to ignition. The key element in the device is a high temperature optical fiber made of single-crystal alumina (sapphire) with a thin film of platinum deposited on one end. Temperature is derived from the intensity of thermal radiation emitted by the platinum and collected by the fiber. The device is capable of measuring rapid gas temperature fluctuations, in excess of 10kHz, in harsh environments where thermocouple life is severely limited by oxidation, corrosion, or erosion. A second configuration of the device collects infrared radiation directly from a solid object and operates in the mid-infrared to detect lower temperatures. The temperature of a confined pyrotechnic has been measured in the range from 370 to 1100 K at heating rates greater than 100 K per microsecond.

39459 (AGARD-CP—99, pp vp) **Turbine rotor blade measurements using infrared pyrometry.** Koschel, W.; Salden, D.; Hoch, T. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

An infrared pyrometer system was developed for the noncontacting measurement of metal temperatures on turbine rotor blades. The system with a high bandwidth ratio, a small target size and a high signal-to-noise ratio meets the requirements for the accuracy of temperature measurements to be performed on small gas turbines running at high speeds. The system set-up is described and special features of the probe head design, the lay-out of the detector/amplifier unit and the signal processing are discussed in detail. Results of the automated calibration of an infrared pyrometer system concerning the influence of variations in the target-to-lens distance, in the lens stop diameter and in the observation angle on the detector signal output are reported. Finally some results of temperature measurements obtained for the cooled rotor blades of a small research turbine are presented.

39460 (AGARD-CP—99, pp vp) **High response data acquisition system.** Fall, M.K.; Dress, H.P. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

High response instrumentation is used frequently in gas turbine engine testing to determine the transient and dynamic behavior of various engine and component parameters. The Naval Air Propulsion Center (NAPC) enhanced its data acquisition and analysis capability in April 1983 with a new digital high response data acquisition system which eliminated many of the problems inherent with older analog data acquisition and analytical methods. This system has the capability of acquiring multiple parameters simultaneously at an aggregate sampling rate of up to 48,000 samples per second with on-line digitization and real time recording on a private data disk. The NAPC offline data analysis system provides same-day access to the data with the capability to display the data in various tabular and graphical formats. Analytical techniques available include time zero analysis, high pass, low pass, and band pass digital filtering, and power spectral density analysis using fast fourier transformations.

39461 (AGARD-CP—99, pp vp) **Processing techniques for correlation of LDA and thermocouple signals.** Nina, M.N.R.; Pita, G.P.A. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

A technique was developed to enable the evaluation of the correlation between velocity and temperature, with laser Doppler anemometer (LDA) as the source of velocity signals and fine wire thermocouple as that of flow temperature. The discontinuous nature of LDA signals requires a special technique for correlation, in particular when few seeding particles are present in the flow. The thermocouple signal was analog compensated in frequency and the effect of the value of time constant on the velocity temperature correlation was studied.

39462 **(BMFT-FB-T—86-162) Rotating flame burner and dust removal: Operation of the Niederberg test facility. Final report.** Luettger, H.; Krauss, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.)). Dec 1986. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770195.

Based on the rotating flame burner developed during the previous project 03E-6072-A an improved prototype was designed and tested. The new burner incorporating a precombustion chamber has got a dry ash removal, thermal layout has been optimized. After commissioning the burner was running without cease for about 1,500 hours showing good results. During that trial the additionally developed pulverized coal dosing system worked reliably. Moreover several ways of reducing flue gas emissions were tested with variabel results. With 1 ref., 6 figs.

39463 **(N—87-20267) NASA-Chinese aeronautical establishment (CAE) symposium.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 230p. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—). NTIS, PC A01/MF A01.

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

Several topics relative to combustion research are discussed. A numerical study of combustion processes in afterburners; the modeling of turbulent, reactive flow; gas turbine research; modeling of dilution jet flow fields; and chemical shock tubes as tools for studying high-temperature chemical kinetics are among the topics covered.

39464 (N—87-20267, pp vp) **Combustion research in the Internal Fluid Mechanics Division.** Mularz, E.J. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

The goal of this research is to bring computational fluid dynamics to a state of practical application for the aircraft engine industry. The approach is to have a strongly integrated computational and experimental program for all the disciplines associated with the gas turbine and other aeropropulsion systems by advancing the understanding of flow physics, heat transfer, and combustion processes. The computational and experimental research is integrated in

the following way: the experiments that are performed provide an empirical data set so that physical models can be formulated to describe the processes that are occurring - for example, turbulence or chemical reaction. These experiments also form a data base for those who are doing code development by providing experimental data against which the codes can be verified and assesed. Models are generated as closure to some of the numerical codes, and they also provide physical insight for experiments. At the same time, codes which solve the complete Navier-Stokes equations can be used as a kind of numerical experiment from which far more extensive data can be obtained than ever could be obtained experimentally. This could provide physical insight into the complex processes that are taking place. These codes are also exercised against experimental data to assess the accuracy and applicability of models.

39465 (N—87-20267, pp vp) **Numerical study of combustion processes in afterburners.** Zhou, X.; Zhang, X. (Shenyang Aeroengine Research Institute, China). 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

Mathematical models and numerical methods are presented for computer modeling of aeroengine afterburners. A computer code GEMCHIP is described briefly. The algorithms SIMPLER, for gas flow predictions, and DROPLET, for droplet flow calculations, are incorporated in this code. The block correction technique is adopted to facilitate convergence. The method of handling irregular shapes of combustors and flameholders is described. The predicted results for a low-bypass-ratio turbofan afterburner in the cases of gaseous combustion and multiphase spray combustion are provided and analyzed, and engineering guides for afterburner optimization are presented.

39466 (N—87-20267, pp vp) **Modeling turbulent, reactig flow.** Claus, R.W. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

Several of the approximations or models involved in the development of a numerical combustor flow code are examined. In the first section, the importance of numerical accuracy is illustrated, and the impact that improved-accuracy schemes have on slowing convergence is demonstrated. Solution algorithms that can speed convergence are discussed and some performance features of these algorithms are illustrated. A sample calculation displaying the importance of boundary conditions on a three-dimensional numerical prediction is presented. The inaccuracy of a current turbulence model in highly turbulent (nonequilibrium) regions is described. Finally, the surprisingly good performance of a six-flux model in describing radiation heat transfer is displayed. In all the areas examined, continued research is still needed, but valuable engineering tools are available today.

39467 (N—87-20267, pp vp) **Experimental and analytical investigation of the variation of spray characteristics along a radial distance downstream of a pressure-swirl atomizer.** Chin, J.S.; Li, W.M.; Wang, X.F. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

The variation of spray characteristics along a radial distance downstream of a pressure-swirl atomizer was measured by laser light-scattering technology. An analytical model was developed to predict the variation of spray characteristics along the radial distance. A comparison of the predicted and experimental data showed excellent agreement. Therefore, the spray model proposed, although relatively simple, is correct and can be used, with some expansion and modification of the prepared model, to predict more complicated spray systems.

39468 (N—87-20267, pp vp) **Combustion research activities at the Gas Turbine Research Institute.** Shao, Z. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

The Gas Turbine Research Institute (GTRI) is responsible mainly for basic research in aeronautical propulsion. An annular diffuser for the turbofan augmentor, combustor ignition performance, combustor airflow distribution, fuel injectors, a vaporizer fuel injector, and an airblast atomizer are discussed.

39469 (N—87-20267, pp vp) **Thermodynamics and combustion modeling.** Zeleznik, F.J. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

Modeling fluid phase phenomena blends the conservation equations of continuum mechanics with the property equations of thermodynamics. The thermodynamic contribution becomes especially important when the phenomena involve chemical reactions as they do in combustion systems. The successful study of combustion processes requires (1) the availability of accurate thermodynamic properties for both the reactants and the products of reaction and (2) the computational capabilities to use the properties. A discussion is given of some aspects of the problem of estimating accurate thermodynamic properties both for reactants and products of reaction. Also, some examples of the use of thermodynamic properties for modeling chemically reacting systems are presented. These examples include one-dimensional flow systems and the internal combustion engine.

39470 (N—87-20267, pp vp) **Theoretical kinetic computations in complex reacting systems.** Bittker, D.A. 1986. NTIS, PC A01/MF A01. (NASA-CP—2433; E—3033; NAS—1.55:2433; CONF-8509404—).

From NASA-Chinese aeronautical establishment (CAE) symposium; Cleveland, OH, USA (23 Sep 1985).

NASA Lewis' studies of complex reacting systems at high temperature are discussed. The changes which occur are the result of many different chemical reactions occurring at the same time. Both an experimental and a theoretical approach are needed to fully understand what happens in these systems. The latter approach is discussed. The differential equations which describe the chemical and thermodynamic changes are given. Their solution by numerical techniques using a detailed chemical mechanism is described. Several different comparisons of computed results with experimental measurements are also given. These include the computation of (1) species concentration profiles in batch and flow reactions, (2) rocket performance in nozzle expansions, and (3) pressure versus time profiles in hydrocarbon ignition processes. The examples illustrate the use of detailed kinetic computations to elucidate a chemical mechanism and to compute practical quantities such as rocket performance, ignition delay times, and ignition lengths in flow processes.

39471 (NP—7752616) **Pros and cons of wood waste-fired heating systems for farming with particular respect to the competitive conditions within the 100 kW power range.** Schwaiger, W. (Oesterreichisches Kuratorium fuer Landtechnik, Vienna). 1986. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752616.

At present Austria is counting about 200 actively operating wood waste-fired heating systems with nominal outputs up to 100 kW. Both the cultivation of forests and industry are producing lean and unvieldy wood wastes which quickly and easily can be chopped to size by means of wood choppers. The chips produced provide for fuels which are characterized by their easy manipulation. The publication abstracted objectively discusses whether and to what extent wood waste-fired heating systems will eventually replace conventional solutions, that is billet wood and oil-fired heating systems. Detailed surveys are given of the different stages of wood chip production and utilization on farms, the cost and competitive conditions to be considered (general considerations, wood waste minimum and maximum costs, economic analyses and practical requirements, economic conclusions). The final chapters are dedicated to pollution abatement, operating convenience and maintenance, pros and cons in general. Due to the favourable conditions

and circumstances wood waste-fired heating systems are expected to be spreading continuously. (HWJ).

39472 **(PB—87-178380/XAB) Marion County solid waste-to-energy facility boilers 1 and 2. Air emissions source test report. Executive summary.** (Ogden Projects, Inc., Emeryville, CA (USA)). 5 Dec 1986. 45p. NTIS, PC A03/MF A01.

The report presents the results of source testing conducted at the Ogden Martin Systems of Marion, Inc., facility in Marion County, Oregon. The 550 tons-per-day facility has two municipal solid waste-fired boilers, each equipped with dry-acid-gas scrubbing equipment and a baghouse. Source testing was conducted at the stack for nitrogen oxides, sulfur dioxide, carbon monoxide, total suspended particulate, volatile organic compounds, lead, beryllium, mercury, chlorides, fluoride, and tetra through octa-chlorodibenzo-o-dixons and -chlorodibenzofurans.

39473 **Heat-exchanger network analysis. 1. Optimization.** Terrill, D.L.; Douglas, J.M. (Dept. of Chemical Engineering, Univ. of Massachusetts, Amherst, MA). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 685-690(Apr 1987).

The results of three case studies, where excess raw materials costs exceed the total energy costs, show that cost savings of about 1-6% are obtained with energy integration using fixed flows and a fixed approach temperature, whereas cost savings of about 20-30% are obtained from the simultaneous optimization of flows with energy integration. Also, Townsend and Linnhoff's minimum area calculation is shown to be a good approximation for heat-exchanger networks in optimization calculations at the conceptual level of a design. Thus, this simple approximation can be used to estimate the optimum flows, and the results can then be used to design a network for preliminary designs.

39474 **Heat-exchanger network analysis. 2. Steady-state operability evaluation.** Terrill, D.L.; Douglas, J.M. (Dept. of Chemical Engineering, Univ. of Massachusetts, Amherst, MA). *Industrial and Engineering Chemistry Research;* **26**: No. 4, 691-695(Apr 1987).

In cases where the optimum design of heat-exchanger network alternatives have about the same processing costs, the selection of the network for the final design may be based on process operability or other considerations. Most heat-exchanger networks are not operable at the optimum steady-state design conditions; i.e., normally they can tolerate disturbances that decrease the loads but not those that increase loads and there are not an adequate number of manipulative variables to be able to satisfy the process constraints and to optimize all of the significant operating variables.

39475 **Structure and oxidation of carbonaceous cenospheres.** Gavalas, G.R.; Loewenberg, M.; Bellan, J.; Clayton, R.M. New York, NY; American Institute of Chemical Engineers (1985). 27p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Technical Paper 30D.

Carbonaceous cenosphere particles from an oil furnace are characterized by scanning electron microscopy, mercury intrusion and nitrogen adsorption porosimetry. The porosimetry data are used to construct a random pore model describing the evolution of surface area and pore volume distribution. The pore model is combined with gas phase transport to formulate the equations for transient particle combustion and some numerical solutions are presented.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 39264

4230 Marine Engineering

39476 **(GKSS—86/E/53) 'GUSI' contributes to further development of underwater technology.** Schafstall, H.G. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 9p. NTIS, PC E07; Available from NTIS as TIB/B87-06463.

Underwater technology is a steadily growing part of offshore technology. The German underwater simulator 'Gusi' contributes to the development of high-tech products and permits them to be tested in near-practice conditions as well as establishing references in reproducible conditions. Testing of the simulator ended in May 1986 after eight successful saturation dives were carried out. A safety certificate was issued by Germanischer Lloyd.

39477 **(IFP—33-118) Parametric instabilities in floating body motion. Application to loading buoys.** Chantrel, J.M. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). 22 Nov 1984. 219p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752672.

The behavior of floating bodies in the swell is not always forecasted by classical calculation based on linear response. In particular it can be characterized by large motion for low swell amplitudes. Parametric resonance are evidenced by experiments and explained by Mathieu's theory. Modelling of the buoy behavior is obtained from experimental parameters (damping, added masses) or theoretical parameters (hydrostatics). Non linear motion equations are integrated and results are compared to experiments.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 38803, 39357

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 39638, 39915, 39919, 39923, 40003

39478 **(DOE/SF/00515—T77) Stanford Linear Accelerator Center: Monthly report for May 1987.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. Contract AC03-76SF00515. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011307.

Operational activities for the month of May 1987 are reported in the areas of Accelerator and Research Operations, Research Area and Experiment Status, and Publications Issued during the month.

39479 **(FNAL-TM—1459) Skyshine from the SSC [superconducting super collider] interaction regions.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 6p. (CONF-8705134—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010999.

From Workshop on radiological aspects of SSC operation; Berkeley, CA, USA (4 May 1987).

This report calculates the neutron fluence from collisions at the superconducting super collider. The motivation for these calculations is shielding considerations in the collision halls of the collider. (JDH)

39480 **(FNAL-TM—1460) Review of the abort dump shown in the SSC [superconducting super collider] conceptual design report.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 18p. (CONF-8705134—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010998.

From Workshop on radiological aspects of SSC operation; Berkeley, CA, USA (4 May 1987).

This report details the design of the abort dump for the Superconducting Super-Collider (SSC). The dump is made from graphite and designed to absorb the maximum beam energy of 400 MJ. The report considers long time activation effects of the dump components. The report concludes that the basic design of the abort dump is well defined. (JDH)

39481 **(FNAL-TM—1461) Checking the numbers for the labyrinths shown in the SSC [Superconducting Super Collider] conceptual design.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 9p. (CONF-8705134—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010997.

From Workshop on radiological aspects of SSC operation; Berkeley, CA, USA (4 May 1987).

Reviewed are the designs for access labyrinths presently shown in the Conceptual Design Report to see if they are reasonable for radiation protection purposes. This matter was previously studied two years ago in a Fermilab TM (Co85a). The methods used are based upon scaling the results of calculations done by Gollon and Awschalom. Confidence in the results has been fortified by a successful experimental test. The Conceptual Design Report shows two types of access labyrinths which are significantly different. The first type is that at a Sector Service Area, while the second is that provided for personnel entry to the Interaction Regions.

39482 **(JAERI-M—86-112) JAERI TANDEM, LINAC and V.D.G. annual report, 1985. April 1, 1985-March 31, 1986.** (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 231p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702516.

This annual report describes research activities which have been performed with the JAERI tandem accelerator, the electron linear accelerator and the Van de Graaff accelerator from April 1, 1985 to March 31, 1986. Summary reports of 52 papers, and list of publications, personnel and cooperative researches with universities are contained.

39483 **(LBL—23413) The Light Ion Biomedical Research Accelerator (LIBRA) .** Gough, R.A. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 12p. (CONF-861271—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011227.

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

LIBRA is a concept to place a light-ion, charged-particle facility in a hospital environment, and to dedicate it to applications in biology and medicine. There are two aspects of the program envisaged for LIBRA: a basic research effort coupled with a program in clinical applications of accelerated charged particles. The operational environment to be provided for LIBRA is one in which both of these components can coexist and flourish, and one that will promote the transfer of technology and knowledge from one to the other. In order to further investigate the prospects for a Light Ion Biomedical Research Accelerator (LIBRA), discussions are underway with the Merritt Peralta Medical Center (MPMC) in Oakland, California, and the University of California at San Francisco (UCSF). In this paper, a brief discussion of the technical requirements for such a facility is given, together with an outline of the accelerator technology required. While still in a preliminary stage, it is possible nevertheless to develop an adequate working description of the type, size, performance and cost of the accelerator facilities required to meet the preliminary goals for LIBRA.

39484 **(RCNP-P—69) Fifteenth period report on the cooperative utilization of the AVF cyclotron at Osaka University RCNP (Dec 1982 - Apr 1983).** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 15 Jun 1984. 95p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702541.

The AVF cyclotron at the RCNP (Research Center for Nuclear Physics) of Osaka University has been cooperatively used by various researchers of Japanese universities or colleges. This collective report covers papers concerning various studies performed at the AVF during Dec 1982 to Apr 1983. Some of the titles of these papers are as follows : Elastic scattering of 56 MeV polarized deuterons from ^{12}C and ^{40}Ca; Pionic three-nucleon capture reactions ; Measurement on branching ratios of short-lived beta emitter ^{23}Mg and its hyperfine interactions; Half-life and branching ratios of short-lived beta emitter ^{13}O; ^{7}Li excitation of the giant resonances in ^{208}Pb; Measurements of spin polarization of residual nuclei after light particle emission in heavy ion reactions; Target dependence of the sequential alpha decay through the narrow resonances of ^{20}Ne; Analyzing power of neutron continuum spectra for the ^{93}Nb (p,nx) reaction and a simple one step OWBA analysis; Energy dependence of the reaction mechanism for the ^{3}He and alpha induced reactions; Medium energy gamma rays following radiative capture of polarized protons on light nuclei.

39485 **(RCNP-P—70) Sixteenth period report on the cooperative utilization of the AVF cyclotron at Osaka University RCNP (May 1983 - Oct 1983).** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 16 Aug 1984. 98p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702542.

The AVF cyclotron at the RCNP (Research Center for Nuclear Physics) of Osaka University has been cooperatively used by various researchers of Japanese universities or colleges. This collective report covers papers concerning various studies performed on the AVF during May 1983 to Oct 1983. About 30 individual papers are presented (some in English and the others in Japanese).

39486 **(RCNP-P—72) Seventeenth period report on the cooperative utilization of the AVF cyclotron at Osaka University RCNP (Nov 1983 - Mar 1984).** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 30 Jan 1985. 136p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702543.

The AVF cyclotron at the RCNP (Research Center for Nuclear Physics) of Osaka University has been cooperatively used by various researchers of Japanese universities or colleges. This collective report covers papers concerning various studies performed on the AVF during Nov 1983 to Mar 1984. About 40 individual papers are presented (some in English and the others in Japanese). (Aoki, K.).

39487 **(RCNP-P—77) Summary of discussions on the next project at RCNP, Osaka University.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1985. 123p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702547.

A meeting was held in May 1985 to discuss what should be the next project of RCNP (Research Center for Nuclear Physics), Osaka University, in relation with other similar projects in Japanese Universities or institutes. About 70 researchers from various universities and institutes in Japan gathered and discussed new nuclear physics projects including a 300 MeV cyclotron. Before entering discussions some short reports conserning selection of machine, requirement from physical studies or political problems were presented. And some selected commentators gave short comments for active discussions. All these reports and comments are included in this collective report. (Aoki, K.).

39488 **(SAND—87-0150) Dielectric cavity, IFR Guided Recirculating Linear Accelerator.** Hasti, D.E.; Tucker, W.K.; Shope, S.L.; Prestwich, K.R.; Miller, R.B.; Rienstra, W.W. (Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., McLean, VA (USA)). Jun 1987. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011612.

An accelerator technology concept which has the potential to meet future Army and Navy mission requirements is the Dielectric Cavity, IFR Guided Recirculating Linear Induction Accelerator (IFRR). This paper presents the advantages of this concept and the areas of research to be pursued to establish the viability of this accelerator concept, review experimental and theoretical results, outline the on-going research program, and present a point design and scaling relations for a conceptual IFRR which is based on properties of materials which are near-term state-of-the-art.

39489 **(SLAC-PUB—4208) Alignment of the Stanford Linear Collider Arcs: Concepts and results.** Pitthan, R.; Bell, B.; Friedsam, H.; Pietryka, M.; Oren, W.; Ruland, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—199). NTIS, PC A02. File Number DE87010318.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The alignment of the Arcs for the Stanford Linear Collider at SLAC has posed problems in accelerator survey and alignment not encountered before. These problems come less from the tight tolerances of 0.1 mm, although reaching such a tight statistically defined accuracy in a controlled manner is difficult enough, but from the absence of a common reference plane for the Arcs. Traditional circular accelerators, including HERA and LEP, have been designed in one plane referenced to local gravity. For the SLC Arcs no such single plane exists. Methods and concepts developed to solve these and other problems, connected with the unique design of SLC, range from the first use of satellites for accelerator alignment, use of electronic laser theodolites for placement of components, computer control of the manual adjustment process, complete automation of the data flow incorporating the most advanced concepts of geodesy, strict separation of survey and alignment, to linear principal component analysis for the final statistical smoothing of the mechanical components.

39490 **(UCRL—94771) Linear induction accelerators.** Briggs, R.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 5p. (CONF-860629—79). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009567.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The development of linear induction accelerators has been motivated by applications requiring high-pulsed currents of charged particles at voltages exceeding the capability of single-stage, diode-type accelerators and at currents too high for rf accelerators. In principle, one can accelerate charged particles to arbitrarily high voltages using a multi-stage induction machine, but the 50-MeV, 10-kA Advanced Test Accelerator (ATA) at LLNL is the highest voltage machine in existence at this time. The advent of magnetic pulse power systems makes sustained operation at high-repetition rates practical, and this capability for high-average power is very likely to open up many new applications of induction machines in the future. This paper surveys the US induction linac technology with primary emphasis on electron machines. A simplified description of how induction machines couple energy to the electron beam is given, to illustrate many of the general issues that bound the design space of induction linacs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 39412, 39506, 39507, 39508, 40219, 40228

39491 **(DOE/ER/40304—1) Polarized electrons at the Bates Linear Accelerator Center.** Souder, P.A.; Kim, D.H.; Kumar, K.; Schulze, M.; Lubell, M.; Patch, J.S.; Wilson, R.; Dodson, G.W.; Dow, K.A.; Flanz, J. (Syracuse Univ., NY (USA); City Univ. of New York, NY (USA); Harvard Univ., Cambridge, MA (USA); Massachusetts Inst. of Tech., Cambridge (USA); Yale Univ., New Haven, CT (USA)). 1986. Contract FG02-86ER40304. 4p. (CONF-8609151—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010364.

From 7. international symposium on high energy spin physics; Protvino, USSR (22 Sep 1986).

A beam of polarized electrons have successfully been injected into the MIT Bates Linear Accelerator and accelerated it to 250 MeV. The intense beam was produced by photoemission from a GaAs crystal. The electron polarization at full energy, as measured by a brief test based on Moller scattering from a magnetized foil, was in excess of 30%. The peak intensity for the 15 μsec long pulses during the first test was about 2mA, representing about a third of the design value. The pulse rate of the accelerator was reduced to 60 Hz to minimize the total beam on the iron target. In a subsequent test, in which the beam hit a thick carbon target, the facility operated successfully at the full rate of 600 Hz. Under this condition, the average current on target was about 10 μA.

39492 **(LBL—23323) Advanced accelerator methods: The cyclotrino.** Welch, J.J.; Bertsche, K.J.; Friedman, P.G.; Morris, D.E.; Muller, R.A. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 33p. (CONF-8602126—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87010975.

From Mass spectrometry conference; Irvine, CA, USA (15 Feb 1986).

Several new and unusual, advanced techniques in the small cyclotron are described. The cyclotron is run at low energy, using negative ions and at high harmonics. Electrostatic focusing is used exclusively. The ion source and injection system is in the center, which unfortunately does not provide enough current, but the new system design should solve this problem. An electrostatic extractor that runs at low voltage, under 5 kV, and a microchannel plate detector which is able to discriminate low energy ions from the ^{14}C are used. The resolution is sufficient for ^{14}C dating and a higher intensity source should allow dating of a milligram size sample of 30,000 year old material with less than 10% uncertainty.

39493 **(SLAC-PUB—4199) Superconducting quadrupoles for the SLC final focus.** Erickson, R.; Fieguth, T.; Murray, J.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 3p. (CONF-870302—192). NTIS, PC A02. File Number DE87010319.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The final focus system of the SLC will be upgraded by replacing the final quadrupoles with higher gradient superconducting magnets positioned closer to the interaction point. The parameters of the new system have been chosen to be compatible with the experimental detectors with a minimum of changes to other final focus components. These parameter choices are discussed along with the expected improvement in SLC performance.

39494 **Intrabeam scattering at high energies.** Parzen, G. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **256**: No. 2, 231-240(1 May 1987).

The growth of a beam of charged particles due to intrabeam scattering is studied in the high energy limit. The variation of the β-functions and the dispersion around the accelerator are included. In the high γ limit, analytical results are found for the horizontal, vertical and longitudinal growth rates. For a lattice consisting only

of regular cells, with no insertions, a time invariant is found and the longitudinal and transverse growth rates are simply related. The dependence of the final state of the beam on the final energy is also studied.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 39480, 39492, 39518, 39652, 39880, 39891, 39920, 40269

39495 (BNL—39848) A circular aperture magnetron for injection into an RFQ. Alessi, J.G. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 7p. (CONF-8610115—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010754.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A magnetron with a circular anode aperture and a spherical dimple in the cathode has been operated. With this configuration, a normalized emittance (90%) of 0.1πcm-mrad has been measured in both planes for an H^- current of >50 mA. Other than this symmetric emittance, the source performance is the same as with the typical anode slit and grooved cathode.

39496 (FNAL-TM—1451) Tests of prototype SSC magnets. Strait, J. (Fermi National Accelerator Lab., Batavia, IL (USA); Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA)). 24 Apr 1987. Contract AC02-76CH03000. 4p. (CONF-870302—195). NTIS, PC A02/MF A01. File Number DE87010300.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Results are presented from tests of the first two full length prototype SSC dipole magnets. Magnetic field measurements have been made at currents up to 2000 A. The two magnets achieved peak currents at 4.5K of 5790 A and 6450 A, respectively, substantially below the short sample limit of 6700 A. These peak values, however, could not be achieved reproducibly. Data are presented from studies performed to try to understand the poor quench performance.

39497 (FNAL-TM—1455) Single wire drift chamber design. Krider, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Mar 1987. Contract AC02-76CH03000. 35p. NTIS, PC A03. File Number DE87011002.

This report summarizes the design and prototype tests of single wire drift chambers to be used in Fermilab test beam lines. The goal is to build simple, reliable detectors which require a minimum of electronics. Spatial resolution should match the 300 μm rms resolution of the 1 mm proportional chambers that they will replace. The detectors will be used in beams with particle rates up to 20 KHz. Single track efficiency should be at least 99%. The first application will be in the MT beamline, which has been designed for calibration of CDF detectors. A set of four x-y modules will be used to track and measure the momentum of beam particles.

39498 (LBL—22266) A high gradient quadrupole magnet for the SSC [Superconducting Super Collider]. Taylor, C.; Caspi, S.; Helm, M.; Mirk, K.; Peters, C.; Wandesforde, A. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—205). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011092.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A quadrupole magnet for the SSC has been designed with a gradient of 234 T/m at 6500 A. Coil ID is 40 mm. The two-layer windings have 9 inner turns and 13 outer turns per pole with a wedge-shaped spacer in each layer. The 30-strand cable is identical to that used in the outer layer of the SSC dipole magnet. Interlocking aluminum alloy collars are compressed around the coils using a four-way press and are locked with four keys. The collared coil is supported and centered in a cold split iron yoke. A one-meter model was constructed and tested. Design details including quench behavior are presented.

39499 (LBL—23007) An interference wiggler for precise diagnostics of electron beam energy. Kim, Kwang-Je. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 4p. (CONF-870302—202-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011095.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Relativistic electrons passing through two identical magnetic sections generate synchrotron radiation whose spectrum is strongly modulated as the photon energy varies. The modulation is caused by the interference of radiation from each section, and has been observed in the spectrum of spontaneous radiation from transverse optical klystron which utilizes two undulators. In this paper, another device based on two simple wigglers is analyzed. The device, which will be called the interference wiggler, can be used for precise diagnostics of electron beam energy; by analyzing the modulated spectrum with a monochromator, the electron energy can be determined up to an accuracy of 10^{-3} or 10^{-4}. General design criteria for interference wigglers are developed. Several example designs are given for measurement of the electron energy for the planned electron beam facility at CEBAF for the 1 to 2 GeV Light Source at Berkeley.

39500 (RCNP-P—68) Proceedings of the workshop on the production and acceleration of the polarized heavy ion beams and their applications to nuclear physics. Tanaka, Masayashi; Shimoda, Tadashi (eds.). (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1984. 65p. (CONF-8402177—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702540.

From Workshop on the production and acceleration of the polarized heavy ion beams and their applications to nuclear physics; Ibaraki, Japan (3 Feb 1984).

The RCNP (Research Center for Nuclear Physics) of Osaka University has a future plan to construct a 4-sector SSC (Separated Sector Cyclotron; K - 300 MeV) accompanied with a small AVF injection cyclotron. The titles of the presented papers are as follows : (1) Sources for negative polarized heavy ion. (2) Optical pumping by LASER light. (3) Polarized heavy ion source with optical pumping. (4) Polarized /sup 3/He ion source. (5) Heavy ion acceleration at the INS SF cyclotron. (6) Design study of Riken ECR ion source, ECR 2. (7) Design of a polarized heavy ion source by use of the tilted foil technique. (8) Acceleration of polarized heavy ions in the proposed ring cyclotron at RCNP. (9) Polarization phenomena in heavy ion reactions. (10) Comment on the spin polarization of protons emitted in heavy ion reactions. (11) Physics using polarized heavy ion beams seen by the high energy heavy ion physicists. (12) Interactions between polarized heavy ions and nuclei in the intermediate energy, suggested from those in the low energy. (13) Past lessons of spin physics by polarized p(d) beam and future prospect of polarized heavy ion experiment. (14) Polarizations in low-energy scattering of heavy ions and some prospects in high energies. (15) Physics with polarized secondary beams. (16) Possible methods to polarized secondary beams and products by means of optical pumping. (Aoki, K.).

39501 (SAND—87-0083C) A multi-megavolt, two-microsecond electron beam diode. Clark, R.S.; Buttram, M.T.; Poukey, J.W.; Lockner, T.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011060.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

An electron beam diode has been developed that operates in the multi-megavolt, microsecond regime. The diode was developed as part of the Troll Electron Beam Accelerator Program. It is a foilless diode with a field emission (cold) cathode designed to produce a 1-kA to 10-kA beam at up to 4 MV. It employs a unique cathode geometry to prevent excessive beam divergence. The diode has been operated in the 2-MV to 3.5-MV range. Currents at the present operating parameters are 1.8 kA to 3.0 kA. A description of the diode, the diode design criteria, and experimental results to date will be presented.

39502 **(SLAC-PUB—4101) Implementation of nonintercepting energy spread monitors.** Sheppard, J.C.; Bambade, P.S.; Clendenin, J.E.; Gromme, T.E.; Jobe, R.K.; Phinney, N.; Ross, M.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 4p. (CONF-870302—197). NTIS, PC A02. File Number DE87010321.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Stripline beam position monitors (BPMs), located in regions of large dispersion, are being used to monitor the relative energy spread of beams injected into the SLC damping rings. Several BPMs have been configured so that the quadrupole moment as well as the dipole moment (beam position) information is generated in hardware. The dipole moment is subtracted in quadrature from the quadrupole moment to produce a signal which is related to the beam width but which is independent of the beam position. Data reduction and averaging is accomplished in the control system microprocessors. Additional data handling occurs in the host computer. Beam width signals from the devices are used in conjunction with RF phase adjustments to minimize the energy spread of the beams. A computer controlled feedback loop has been developed to oversee the process of energy spread manipulation.

39503 **(SLAC-PUB—4303) The Mark III vertex chamber: Studies using DME.** Pitman, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 5p. (CONF-8703128—4). NTIS, PC A02. File Number DE87010844.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

Studies have been performed using a prototype of a pressurized wire vertex chamber with 8 mm diameter straw geometry. A 35 μm spatial resolution using dimethyl ether (DME) at 1 bar and 30 μm using argon ethane (50/50 mixture) at 4 bar was obtained. Preliminary studies show the DME to adversely affect such materials as aluminized Mylar and Delrin.

39504 **(UCRL—95404) Optical diagnostics in the advanced test accelerator (ATA) environment.** Chong, Y.P.; Cornish, J.P.; Donnelly, D. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 7p. (CONF-870584—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010338.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

The ATA is a 50-MeV, 10-kA, 70-ns pulsed electron beam accelerator that generates an extremely harsh environment for diagnostic measurements. Diagnostic targets placed in the beamline are subject to damage, frequently being destroyed by a single pulse. High radiation (x-ray, gamma, and neutron) and electromagnetic interference levels preclude placing components near the beamline that are susceptible to radiation damage. Examples of such components are integrated circuit elements, hydrocarbons such as Teflon insulation, and optical components that darken, resulting in transmission loss. Optical diagnostics play an important part in measuring experimental parameters such as the beam current density profile. A large number of optical lines of sight (LOS) are routinely deployed along the experimental beamlines that use the ATA beam. Gated TV cameras are located outside the accelerator tunnel, because the tunnel is inaccessible during operations. We will describe and discuss the difficulties, problems, and solutions encountered in making optical measurements in the ATA environment.

4304 Storage Rings

REFER ALSO TO CITATION(S) 39880

39505 **(ANL-HEP—87-29) Vacuum system for the Synchrotron X-ray Source at Argonne.** Wehrle, R.; Moenich, J.; Kim, S.; Nielsen, R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 2p. (CONF-870302—212). NTIS, PC A02. File Number DE87011501.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The vacuum system of the APS storage ring is designed to maintain a beam-on operating pressure of 1 nTorr or less in order to achieve a positron beam lifetime of approximately 20 hours. The vacuum chamber is an aluminum extrusion containing a beam chamber and antechamber. The primary source of the pumping is with NeG strips. The design and location of the crotches and strip absorbers are based on the distribution of the bending magnet synchrotron radiations.

39506 **(BNL—39594) Optimization of compact synchrotron optics for x-ray lithography.** Decker, G.A.; Craft, B.C. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 3p. (CONF-870302—185). NTIS, PC A02. File Number DE87010052.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The production of integrated circuits having sub-micron component dimensions has motivated the development of compact electron storage rings to provide synchrotron x-ray radiation. This paper presents considerations for optimizing the optics for small radius rings using superconducting dipole magnets. The key parameters are the sizes and angular divergences of the source points illuminating the different ports. Two ring designs are compared in terms of theoretical beam parameters achievable using idealized optics.

39507 **(DESY—86-020) Vertical dispersion generated by correlated closed orbit deviations.** Kewisch, J.; Limberg, T.; Rossbach, J.; Willeke, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1986. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-06445.

Vertical displacement of quadrupole magnets is one of the main causes of a vertical dispersion in a flat storage ring and thus a major contributor to the height of an electron beam. Computer simulations of the beam height in the HERA electron ring give a value of the ratio ϵ_z/ϵ_x of more than 10 percent. This large value occurs even for an rms value of the quadrupole vertical displacements Δz as small as 0.01 mm. Such a vertical emittance is much larger than one expects on the base of a theoretical estimate and it is clearly necessary to investigate the origin of the disagreements especially since the beam height has such an important influence on the machine performance. The key to the understanding of this discrepancy lies in the correlations of the closed orbit deviations at different position of the machine. This is investigated in the next section and in the section which follows we derive the expression for the rms value of dispersion and the vertical emittance. Finally the theoretical results are compared with computer simulations.

39508 **(DESY—86-029) Spin-orbit motion in a storage ring in the presence of synchrotron radiation using a dispersion formalism.** Mais, H.; Ripken, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1986. 56p. NTIS, PC E09; Available from NTIS as TIB/B87-06377.

In this report we investigate the spin-orbit motion of particles in storage rings. Having summarized the fully six-dimensional description of the orbital motion with coordinates (x, p_x, z, p_z, σ, eta $= \Delta E/E_0$) we introduce the dispersion. Since the dispersion function is introduced via a canonical transformation, the symplectic structure of the equations of motion (and thus of all the transfer matrices) in the absence of radiation effects is completely preserved. In this formulation the coupling between transverse and longitudinal motion only appears in the cavities. As physical applications of this approach we calculate the damping constants, the beam emittance matrix and the depolarization time.

39509 **(KEK—86-3) Measurement of betatron functions at photon factory storage ring.** Honjo, I.; Tsumaki, K.; Kamiya, Y.; Kihara, M. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702534.

The betatron functions of the storage ring of the Photon Factory at KEK were measured. The measured values of the betatron functions agree with their theoretical values very well. When

the vertical wiggler is excited, tune shifts are produced and the betatron functions are distorted by about 45 % in the horizontal direction and by 30 % in the vertical direction. A simple mathematical model, in which the vertical wiggler is assumed to consist of three rectangular magnets with the sextupole field component, can explain the tune shifts and also can give a good estimate of the distortion of the betatron functions.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 38685, 39437, 39650, 39902, 39905, 40003

39510 **(AD-A—179816/4/XAB) Wall attenuation and scatter characteristics of ionization chambers at Armed Forces Radiobiology Research Institute. Technical report.** Dooley, M.; Eagleson, D.M.; Mohaupt, T.H. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1986. 24p. (AFRRI-TR—86-6). NTIS, PC A02/MF A01.

Ion chambers are used at AFFRI as the primary method of dosimetry. These chambers are calibrated with a cobalt-60 radiation source and are used for dose measurements in high-energy electron, mixed neutron,/gamma, and cobalt-60 radiation fields. Radiation attenuation and scattering in the ion-chamber wall depends on the radiation field and affects the chamber response. A wall correction factor, KW, is used to help eliminate this source of error. The wall correction factor was experimentally determined for cobalt-60 and typical AFRRI mixed neutron/gamma fields.

39511 (INIS-mf—10911, pp 45) **Computer simulation of ^{9}neutron ball': the new generation spin spectrometer.** Yamada, H.; Fabre, B. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39512 (INIS-mf—10911, pp 62) **Measurement of time-of-flight around the Enge spectrometer.** Catford, W.N.; Woods, C.L.; Orr, N.A.; Fifield, L.K. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39513 **(KFK—4166) Performance test of a TMS strip chamber.** Mueller, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Mar 1987. 61p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08671.

A new type of track chamber is presented which uses the room temperature liquid tetramethylsilane (TMS) in an ionization chamber. Performance of the chamber and test results in an electron beam are described. The results demonstrate that this type of chamber is an interesting tracking device particular in an environment of high background radiation.

39514 **(PINSTECH/HPD—112) Calibration of farmer dosemeters.** Ahmad, S.S.; Anwar, K.; Arshed, W.; Mubarak, M.A.; Orfi, S.D. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). Aug 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702538.

The Farmer Dosemeters of Atomic Energy Medical Centre (AEMC) Jamshoro were calibrated in the Secondary Standard Dosimetry Laboratory (SSDL) at PINSTECH, using the NPL Secondary Standard Therapy level X-ray exposure meter. The results are presented in this report.

39515 **(PTB-Dos—15) Investigations of dosimeters with regard to their introduction into personal dose monitoring.** Ambrosi, P.; Boehm, J. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Gruppe Strahlenschutzmetrologie). Oct 1986. 40p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06270.

There are only small differences between film, TL and PL dosimeters regarding the dosimetric properties checked in the annual PTB measurements, such as linearity, range, dependence of the deviation in measurement on photon energy and dependence on angle. The differences between dosimeters of a type of detector are greater than the differences between different types of detectors. Particularly in the area of small doses below 1 m Sv, it was found that the mean value of the variation coefficients for all official film GKD at 19% was nearly equal to that for all unofficial TL-GKD's at 21%. The conversion from the parameter photon equivalent dose in air to a phantom-related parameter is possible for most dosimeters.

39516 (RFP—4036, pp 33-42) **Evaluation of PM-10 commercial inlets for new surveillance air sampler.** Langer, G. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

The purpose of this project is to adapt an existing sampling inlet or develop a new one to collect airborne dust particles <10-μm aerodynamic equivalent diameter. These inlets are necessary to meet new EPA and DOE guidelines for surveillance of nuclear facilities.

39517 **(SLAC-PUB—4297) The data acquisition system for SLD.** Sherden, D.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 15p. (CONF-8703128—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010315.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

This paper describes the data acquisition system planned for the SLD detector, which is being constructed for use with the SLAC Linear Collider (SLC). Analog electronics, heavily incorporating hybrid and custom VLSI circuitry, is mounted on the detector itself. Extensive use is made of multiplexing through optical fibers to a FASTBUS readout system. The low repetition rate of the SLC allows a relatively simple software-based trigger. Hardware and software processors within the acquisition modules are used to reduce the large volume of data per event and to calibrate the electronics. A farm of microprocessors is used for full reconstruction of a sample of events prior to transmission to the host.

39518 **(SLAC-PUB—4317) Prospects for collider vertex detectors.** Ritson, D.M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 10p. (CONF-8703128—3). NTIS, PC A02. File Number DE87010845.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

The technologies available for vertex detection and the restrictions imposed by event topologies and multiple coulomb scattering are discussed. It is shown that ultimate performance limits for collider detectors are set by how close active detection starts relative to the interaction region. This in turn is determined by the machine characteristics and the care taken to provide collimation and shielding to minimize radiation backgrounds.

39519 **(UCRL—94696) Use of the (t,p) reaction for in-beam spectroscopy studies.** Henry, E.A. (Lawrence Livermore National Lab., CA (USA)). 29 May 1986. Contract W-7405-ENG-48. 10p. (CONF-8606130—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009576.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Triton induced reactions, such as the (t,p) reaction, can be used for in-beam gamma-ray and conversion-electron studies of nuclei that are somewhat neutron rich. We have developed systems for both conversion-electron and gamma-ray spectroscopy in coincidence with the outgoing energetic proton to identify the (t,p) reaction channel. Data from the ^{142}Nd(t,pγ) reaction illustrate several of the characteristics of this reaction for studying nuclear structure. Preliminary results from the study of ^{96}Zr by conversion-electron spectroscopy, and ^{240}U by gamma-ray spectroscopy, are reported. 4 refs., 4 figs.

39520 **Evaluation of C-hacekerenkov converters for measuring current density distribution in large-area electron beams.** Samlin, G.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 6, 2169-2172(15 Sep 1987).

An evaluation is presented of several types of C-hacekerenkov converters to study time-resolved current uniformity in large-area electron beams with current densities up to 4 kA/cm^2. The materials used for this study were Mylar, fused silica, glass, and Lucite. The final choice for a C-hacekerenkov converter to be used on a large-area diode was type 0080 clear lime glass, which is a commercial plate glass. The thickness used was 0.32 cm. The glass converter showed excellent time response and correlation of light output to electron current density. This converter survives in intense current beams and is economically available in large sizes.

39521 **Tests of a large air-core superconducting solenoid as a nuclear-reaction-product spectrometer.** Stern, R.L.; Becchetti, F.D.; Casey, T.; Jaenecke, J.W.; Lister, P.M.; Liu, W.Z.; Kovar, D.G.; Janssens, R.V.F.; Vineyard, M.F.; Phillips, W.R.; and others. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Review of Scientific Instruments;* **58**: No. 9, 1682-1693(Sep 1987).

An air-core superconducting solenoid, with a diameter of 0.2 m and a length of 0.4 m, has been configured for use as a heavy-ion reaction-product spectrometer (E/A$\leqq$5 MeV/u) near $\theta = 0°$. The spectrometer has a large solid angle (10—35 msr) and properties suitable for time-of-flight measurements with flight paths approx. > 2 m. The performance of the spectrometer was established using α-particle sources and nuclear-reaction products from heavy-ion collisions. The characteristics of air-core magnets are compared to those of steel-yoke magnets. The simplicity and ease of operation of the air-core magnet, without significant problems from the (axial) fringe fields, suggests that larger air-core magnets with d$\Omega\geqq$20 msr and capable of focusing ions with E/A$\geqq$30 MeV/u are feasible. Other applications of solenoids and combinations of solenoids with radial electric-field lenses (ELCO lenses) are also discussed, including designs which focus more than one charge state simultaneously.

39522 **Microcomputer-controlled perturbed angular correlation spectrometer.** Jaeger, H.; Gardner, J.A.; Su, H.T.; Rasera, R.L. (Department of Physics, Oregon State University, Corvallis, Oregon 97331). *Review of Scientific Instruments;* **58**: No. 9, 1694-1698(Sep 1987).

A four-detector time-differential perturbed angular correlation spectrometer controlled by an inexpensive microcomputer is described. The use of twin-single-channel analyzers permits each detector to identify both gamma rays in the cascade. An improved gating logic system reduces the MCA/computer deadtime and allows larger sample activity and faster data accumulation. The twin-single-channel analyzer and gating circuit additions also permit simultaneous accumulation of two statistically independent sets of four-channel spectra. The spectrometer provides on-line display of raw data and the perturbation function derived from either set of four-channel spectra.

39523 **Removal of phototubes from Pb-glass detectors II.** Alburger, D.E.; Akiba, Y.; Olness, J.W.; Tannenbaum, M.J. (Brookhaven National Laboratory, Upton, New York 11973). *Review of Scientific Instruments;* **58**: No. 9, 1761-1762(Sep 1987). Contract AC02-76CH00016.

A previously described technique for removing faulty phototubes from Pb-glass detectors with heated chloroform has been modified to allow the removal of good phototubes.

39524 **Readout system for multi-crystal gamma cameras.** Derenzo, S.E. (to Dept. of Energy, Washington, DC). US Patent 4,672,207. 9 Jun 1987. Filed date 21 Aug 1985. vp.

This patent describes a radioisotope camera, including: a plurality of scintillation elements in close proximity to each other and arranged in N rows and M columns, N and M being integers, each scintillation element being capable of converting gamma-ray radiation to optical radiation, of solid state photodetectors arranged in N rows and M columns and positioned to receive optical radiation directly from the scintillation elements, there being one photodetector associated with each of the scintillation elements, each of the photodetectors being positioned to receive optical radiation from only the scintillation element with which it is associated. N + M amplifiers, one amplifier associated with each row of the photodetectors and one amplifier associated with each column of the photodetectors, connecting means connecting the photodetectors to the amplifiers so that an amplifier associated with any row of photodetectors will respond to detection of optical radiation of any of the photodetectors in that row, and so that an amplifier associated with any column of photodetectors will respond to detection of optical radiation of any of the photodetectors in that column, position logic means for determining from the responses of the row and column amplifiers the particular row and column of a photodetector receiving optical radiation from the scintillation element with which it is associated.

39525 **Stanford Linear Accelerator Center pulsed x-ray facility.** Ipe, N.E.; McCall, R.C.; Baker, E.D. (Stanford Univ., CA). *Health Physics;* No. 4, 463-468(Apr 1987).

The Stanford Linear Accelerator Center (SLAC) operates a high-energy (up to 33 GeV) linear accelerator delivering pulses up to a few microseconds wide. The pulsed nature of the electron beam creates problems in the detection and measurement of radiation both from the accelerator beam and the klystrons that provide the radio-frequency power for the accelerator. Hence, a pulsed x-ray facility has been built at SLAC mainly for testing the response of different radiation detection instruments to pulsed radiation fields. The x-ray tube consists of an electron gun with a control grid. This provides a stream of pulsed electrons that can be accelerated towards a confined target window. The window consists of Al 0.051 cm (20 mils) thick, plated on the vacuum side with a layer of Au 0.0006 cm (1/4 mil) thick. The frequency of electron pulses can be varied by an internal pulser from 60 to 360 pulses per second with pulse widths of 360 ns to 5 microseconds. The pulse amplitude can be varied over a wide range of currents. An external pulser can be used to obtain other frequencies or special pulse shapes. The voltage across the gun can be varied from 0 to 100 kV. The maximum absorbed dose rate obtained at 6.35 cm below the target window as measured by an ionization chamber is 258 Gy/h. The major part of the x-ray tube is enclosed in a large walk-in cabinet made of 1.9-cm-thick (3/4-inch-thick) plywood and lined with 0.32-cm-thick (1/8-inch-thick) Pb to make a very versatile facility.

39526 **High luminosity considerations.** Platner, E.D. (Brookhaven National Lab., Upton, NY 11973). pp 369-370 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

There appears to be some controversy over how high a luminosity one can use before a variety of detector limitations impose a practical limit. It seems appropriate in this paper to discuss factors leading to flux limitations for a variety of detector types and practical considerations to extending those limits. Attached to this detector group report is a paper giving examples of several detectors that operate in the 10/sup 32/ to 10/sup 33/ luminosity range. This paper also shows a method of reducing the effects of pileup inherent in calorimeter use at L = 10/sup 33//cm/sup 2//sec.

39527 The MPS II - A tracking detector system for large high rate experiments. Platner, E.D. (Brookhaven National Lab., Upton, NY 11973). pp 391-393 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The MPS II tracking detector system was developed for a variety of low cross section experiments that are only practical in a high beam rate environment. It was built as a general purpose device for use in a fixed target (AGS) situation where the beam passes through all elements of the detector. The electronics is deadtimeless so that high efficiency is achieved at event rates as high as 10/sup 6//sec/ch. This capability would allow these detectors to be used as close as 20 cm from a hadron-hadron collider at 1 Tev luminosity up to 10/sup 33//cm/sup 2/sec.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 38673, 39291, 39302, 39303, 39304, 39305, 39308, 39326, 39327, 39346, 39422, 39457, 39458, 39459, 39580, 39587, 39717, 40165, 40286

39528 (AGARD-CP—99) Advanced instrumentation for aero engine components. (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Nov 1986. 556p. (In several languages). (CONF-8605280—). NTIS, PC A24/MF A01.

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The Symposium was addressed to research scientists and development engineers for aero engines in order to discuss the state-of-the-art and to be informed on new measurement possibilities. The scope included Coherent Anti-Stokes Raman Spectroscopy (CARS), laser anemometry, pyrometry, clearance measurement including x-ray, high speed data acquisition and processing, stress measurement and vibration and thin layer technique, unsteady and transient phenomena, and future prospects.

39529 (AGARD-CP—99, pp vp) **Simultaneous temperature measurements with Raman and CARS in laminar flames.** Stricker, W.; Kreutner, W.; Just, T. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Spatially resolved temperature measurements in laminar premixed flames were made using Coherent Anti-Stokes Raman Scattering (CARS) and spontaneous Raman spectroscopy. In the case of narrowband (scanning) CARS, the experimental arrangement allows the performance of simultaneous temperature measurements with both techniques. For broadband (multiplex) CARS the measurements have to be made successively. Three different Raman linewidth models were used for CARS data evaluation. The results were compared with the independently recorded rotational Raman temperatures. Temperature differences up to 10% were observed, depending on the linewidth model used. For two, more complicated linewidth models the CARS and Raman temperatures are in good agreement.

39530 (AGARD-CP—99, pp vp) **Laser-2 focus velocimetry.** Schodl, R. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

A review is given of various publications about L2F-velocimetry. Main emphasis is placed upon the important new advances of this technique. The manner of statistical data analysis of turbulent flows including the simplified version which enables a time-saving measuring procedure is described in some detail. The influence of beam diameter - beam separation ratio on the measuring accuracy and on the measuring time is treated. The capability of the L2F-system at close-to-wall measurements could be further improved. Results of measurements in a very small flow channel and in a small turbocharger compressor rotor are presented. The 3-D version of the L2F-system was successfully operated recently. The principle, the optical set-up and the signal processing are described and some first results are presented. A comparison between Laser Doppler (LD) - and Laser 2 Focus (L2F) velocimeters gives answers about such signal properties as amplitude and rate, the smallest detectable particles and about the measuring time needed, based on the probe volume dimensions.

39531 (AGARD-CP—99, pp vp) **Application of Doppler and transit laser anemometry in small turbomachines.** Elder, R.L.; Forster, C.P.; Gill, M.E. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The selection laser anemometry systems and their application to the particularly hostile environment found in small high speed rotating turbomachines are discussed. There are several different laser anemometry systems which are used in turbomachinery studies and when selecting a system to carry out specific duties it is necessary to have some prior knowledge of the flows to be measured, the spacial resolution required and any limitations on optical access. The optical access will often determine the spatial resolution possible and the quality of the scattered signal will generally determine the type of signal processor which can be used. The criteria used for the selection of systems at Cranfield are discussed. The arrangements in use include both the Doppler and transit systems each of which are found to have unique and very distinct advantages.

39532 (AGARD-CP—99, pp vp) **Evaluation of L2F-measurements in unsteady turbine flow.** Foerster, W.; Schodl, R.; Kruse, H. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The L2F-velocimeter is a suitable device with which to perform experimental studies on instationary effects in turbomachines. The execution and the evaluation of L2F-measurements within and near the rotor blade channel of a single-stage, cold air test turbine are discussed. The measurements provide information on instantaneous distribution of the 2-D flow vector as well as the components of random fluctuating velocity. The turbine rotor flow is periodically unsteady because of the upstream inlet guide vanes. In order to ensure the almost complete reconstruction of all possible rotor-to-stator orientations, the discrete measurements are evaluated by combining a local and chronological interpolation procedure. A discussion of experimental uncertainties in this application of the L2F-technique is included.

39533 (AGARD-CP—99, pp vp) **Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility.** Seasholtz, R.G.; Goldman, L.J. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

A laser anemometer is described that was developed for use in a 508 mm diameter annular turbine stator cascade facility. All three velocity components are measured through a single restricted optical port, both within the stator vane row and downstream of the vanes. The measurements are made through a cylindrical window in the casing that matches the tip radius of the cascade. The stator tested has a contoured hub endwall that results in a large radial flow near the hub. The anemometer uses a standard fringe configuration (LFA) with a fluorescent aerosol seed to measure the axial and circumferential velocity components. The radial component is measured with a confocal Fabry-Perot interferometer. The two configurations are combined in a single optical system and can operate simultaneously. Data are presented to illustrate the capabilities of the system.

39534 (AGARD-CP—99, pp vp) **Utilization of thin film sensors for measurements in turbomachinery.** Bruere, A.; Portat, M.; Godefroy, J.C.; Helias, F. Nov 1986. (In French). NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

Sensor features and data analysis principles for thin films used as pressure and temperature transducers for flowfield measurements in turbomachinery are described. The devices were developed to collect data without affecting the flowfield around fixed and rotating turbine blades. The concept has been extended to thermal fluxmeters for measuring convection of the thermoelectric effect and to measuring the aerodynamics of boundary layer flows by exploiting temperature-induced changes in the resistivity of certain metals. The films have a maximum thickness of 80 microns, can be integrated into the walls of the area under investigation by vapor phase deposition, and require adhesive layers of only 2 to 4 microns. Numerical models are furnished for solid and gaseous dielectric sensor films for pressure measurements and for relating data from a thermal fluxmeter to temperature fields of flow.

39535 (AGARD-CP—99, pp vp) **Vibration analysis by speckle interferometry.** Knoell, H. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

The vibrational modes of complex systems can be visualized with high sensitivity by laser light speckle interferometry. Electronic speckle pattern interferometry (ESPI), in contrast to holography, does not use photo-chemical storage media but, shows a live image of the vibrational modes created by the time-average method directly on a monitor screen. The particular advantage of this very useful and now almost conventional procedure of vibration analysis is demonstrated by two applications to aero-engine parts: a compressor blade and an impeller of a small centrifugal compressor.

39536 (BNL—39818) **Extension of the range of profile measurements by overlapping successive traces.** Church, E.L. (Picatinny Arsenal, Dover, NJ (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870132—11). NTIS, PC A02. File Number DE87010759.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

It has been recently proposed to extend profile measurements by overlapping a number of successive colinear traces to generate a composite trace which is an order of magnitude longer than any individual measurement. This paper presents an error analysis of this method as a guide for its application and improvement. Expressions are derived for: (1) the cumulative rms error of the composite profile, (b) the trade-off between this error, the number of traces required, and the degree of overlap of successive traces, and (3) the power spectral density of the cumulative error. This last is important in the application of the method since - as expected - it predicts that most of the error is concentrated in long surface wavelengths, in precisely the region the method was designed to illuminate. The present analysis suggests that the performance of the method may be improved by using a global fitting procedure rather than the serial method originally considered.

39537 (SAND—87-0930C) **Response of Bauer piezoelectric polymer stress gauges (PVDF) [polyvinylidene fluoride] to shock loading.** Graham, R.A.; Lee, L.M.; Bauer, F. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—32). NTIS, PC A02. File Number DE87012406.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Polyvinylidene fluoride (PVDF) stress gauges fabricated from high quality, biaxially stretched film, and electrically poled to high values of remanent polarization are the basis for revolutionary new gauging capabilities. In the present work, a number of PVDF films have been studied under controlled impact loading to maximum impact stresses of 35 GPa. Gauges with various degrees of polarization were studied. In the impact studies, electrical response with good fidelity was obtained to stress of 20 GPa. At 35 GPa the observed response is highly distorted. Remanent polarization is found to have a significant influence on nonlinearity and probably affects the maximum useful stress for shock gauge applications.

39538 (SAND—87-1268C) **Real-time optical processor for synthetic aperture radar image formation.** Stalker, K.T.; Molley, P.A.; Dickey, F.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870584—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010744.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

An acousto-optic processor which forms synthetic aperture radar images in real-time is described. It employs a space and time integrating architecture to perform the required two dimensional matched filtering operation as a sequence of one dimensional processes. The matched filtering in range is performed on each radar return pulse using the acousto-optic device. The azimuthal matched filtering is performed using a fixed reference mask and a charge-coupled device operating in the time delay and integrate mode. This fixed mask architecture has been modified to include a background subtraction capability to reduce the effects of unwanted bias terms on image quality. The effectiveness of this technique will be analyzed for two different time bandwidth product cases. SAR imagery formed using the real-time optical processor is also presented.

39539 (VTT-TIED—638) **FLOWCER - a flowmeter based on radiotracer techniques.** Turtiainen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1986. 57p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751944.

One of the most difficult problems in the field of flow measurement is the lack of a portable, clamp-on type of flowmeter of good accuracy. This is a serious restriction in non-continuous flow measurements and on-site calibrations of flow meters. One possibility of constructing a meter capable for these measurements is to use tracer techniques, particularly radioisotope tracers. A flow measurement instrument, FLOWCER, has been developed in the Reactor Laboratory of the Technical Research Centre of Finland (VTT). The instrument is based on the radioisotope transit time method. The device can be used for the accurate instantaneous measurement of volume flow rate in ducts. The tracer used is /sup 137m/Ba produced in a portable isotope generator. Because of the short half-life (2.6 min) of /sup 137m/Ba the measurement is radiologically very safe. The device consists of the isotope generator, an injection device for the tracer, radiation detectors, a data logger unit and a micro-computer. Also a transducer for various other quantities than flow may be connected to the analog input channels of the FLOWCER. The measurement program can be modified for measurements of different types. The FLOWCER has been used for the measurememts of energy and material balances, for the on-site calibrations of flow meters and for pump efficiency analysis. The application most frequently used has been the on-site calibration of flow meters. According to the present experience (over 100 calibrated flow meters) the accuracy level of flow measurements can be increased by a factor of ten or more by using the transit time method for on-site calibration.

39540 **Improved time-of-flight ion charge state diagnostic.** Brown, I.G.; Galvin, J.E.; MacGill, R.A.; Wright, R.T. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **58**: No. 9, 1589-1592(Sep 1987). Contract AC03-76SF00098.

A time-of-flight diagnostic for analysis of relatively low-energy ion beams is described. The system incorporates several novel features which improve its performance in a number of ways. The technique is simple and can provide an alternative to magnetic analysis of ion beams for the determination of ion charge state and beam composition.

39541 **Digital back off for computer controlled flash spectrometers.** Davis, F.S.; Nemeth, G.A.; Anjo, D.M.; Makings, L.R.; Gust, D.; Moore, T.A. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287). *Review of Scientific Instruments;* **58**: No. 9, 1629-1631(Sep 1987).

A digital software-controlled back-off system for probe lamp dc signal nullification has been designed and incorporated into a laser flash photolysis spectrometer. This method takes advantage of

modern high-speed operational amplifiers already employed in the detection circuitry and the dedicated small computer that runs the spectrometer. The determination of I_0, necessary for absorbance calculations, is inherent in the method.

4404 Well Logging Instrumentation

39542 (AD-A—179700/0/XAB) New method in elementary-particle detection. Final report, August 1984-December 1986. Weber, J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 31 Mar 1987. 13p. NTIS, PC A02/MF A01.

Total cross sections are measured for coherent elastic scattering of antineutrinos from a reactor, incident on a single crystal of sapphire, with a mass of 100 grams. The cross section is 2.7 sq. cm. + or - .24.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 39320, 40098

39543 (PTB-W—32) Investigations of the course of turbulent gas explosions. Foerster, H.; Steen, H. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme). Oct 1986. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770157.

The course of explosions in turbulent stoichiometric propane/air mixtures is examined on the example of two large volumes of mixtures (closed container). The main point is the determination of the effect of turbulence parameters (mean speed of variation u and mean turbulent ball diameter L) on the turbulent flame speed v/sub t/ which is decisive for damage from explosions out of doors and in closed rooms. The experiments show that the mean turbulent ball diameter is determined by the size of the turbulence field and the geometry of the boundry surfaces. For experimentally accessible intensities of turbulence, there is a nearly linear rise of v/sub t/ with u, with L fixed. It is particularly important that a significant rise is found of v/sub t/ with L (with u fixed). For safety-related assessment of the power of explosions, one has to consider the mean size of the turbulent ball L determined by the mixed volume. The maximum rate of pressure rise of the explosion is, according to the experiments, determined by the state of turbulence of the mixture and by equipment factors, such as the size and geometry of the containers and by the type of initiation of turbulence.

39544 (RISO-R—499) Gas explosion characterization, wave propagation. Larsen, G.C.; Roed, J.; Andersen, S.I. (Risoe National Lab., Roskilde (Denmark)). Oct 1985. 162p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87751932.

A number of experiments have been performed with blast waves arising from the ignition of homogeneous and well defined mixtures of methane, oxygen and nitrogen, contained within spherical balloons with controlled initial dimensions. The maximum flame speed has been of the order of 100 m/s, resulting in positive peak pressures of 50-100 x 10/sup 2/Pa in 5-10 m distance from the source. The explosion process was found to be reasonable symmetric. The attenuation of the blast wave due to vegetation and the influence of obstacles as banks, walls and houses on the pressure field have been investigated. The presence of the bank and the house was felt in a zone with a length corresponding to a typical dimension of the obstacles, whereas the overall pressure field is shown to be unaffected by the the type of obstacles and vegetation investigated. For the wall and house, reflection factors have been established, and some variation over the surface has been measued. The scatter of the pressure measurements is estimated for stable, neutral and unstable atmospheric conditions, and an attempt to determine the ground reflection factor has been performed. Finally the accelerations of a house exposed to the blast wave have been examined.

39545 (SAND—86-2180C) Climatological assessment of explosion airblast propagations. Reed, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 26p. (CONF-870991—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010510.

From 10. international symposium on military applications of blast simulation; Bad Reichenhall, F.R. Germany (21 Sep 1987).

Sound waves or explosion airblast waves are refracted by the atmosphere depending upon temperature-dependent sound speeds and winds at various altitudes. In comparison with propagation expected from a spherical explosion overpressure-distance function, long-range overpressures (below about 2 kPa) may be attenuated by a strong decrease (gradient) in sound velocity with height; they may be enhanced by an inversion or increasing sound velocity with height; or there may be blast focusing by as much as 3 to 5X from complex sound velocity structures. In general, for a wave passing through a layer where sound velocity decreases with height, wave normals (rays) are curved upward away from ground, so that overpressures are subject to excess attenuation compared to undistorted radial propagations from an assumed model explosion. In a layer where sound velocity increases with height, shock rays are curved downward toward the ground. When they strike ground, they are almost perfectly reflected, at least for the low frequencies and long wave lengths of most explosion tests, and follow repetitious paths. At moderate to long ranges, the result is a restriction to near cylindrical wave expansion, rather than spherical, with an associated amplification of wave overpressure, by comparison with an undistorted spherically expanding wave. In the more complex dogleg case, with a decreasing sound velocity strata above the surface capped by a layer of increasing sound velocities (to a value higher than at the surface), the result may be a folding of the wave front to form a caustic (in 3-D) or a focus that may reach the ground. Very strong overpressure amplifications may develop in such foci; 5X overpressure amplifications (25X in energy flux) have been recorded.

39546 (SAND—87-0764C) Homogeneous reactive kinetics applied to granular HNS [hexanitrostilbene]. Kipp, M.E.; Setchell, R.E.; Taylor, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—25). NTIS, PC A02. File Number DE87011724.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Hexanitrostilbene (HNS) is a granular explosive that has been studied in a variety of grain sizes and porosities. One of the formulations, a very fine grained HNS (1 to 2 μm, specific surface area about 8 m^2/g, 8% porosity, reference density 1600 kg/m^3), is a candidate for slapper-detonator application. In reported observations of shock growth-to-detonation, involving shock pressures below 7 GPa, this particular grade of HNS displayed characteristics usually identified with homogeneous explosives. In particular, instead of the typical growth behavior observed in many granular explosives, there is evidence for the formation of superdetonation waves. In the past, models of reactive flow in granular explosives have focused on the formation and subsequent thermal explosion of hot spots, followed by grain burning. The granular structure of the explosive ensures that heterogeneous heating will occur, typically by void collapse. In the limit as grain size, and consequently void size, decreases, we expect that the variation in temperature caused by heterogeneous heating will become smaller (void collapse less effective in creating local hot spots), and thermal transport more effective (surface area/volume of hot spots increases). For the proposed HNS application, it was perceived that a simple homogeneous model, where the reactant is uniformly shock heated and reacts by thermal explosion, might capture the principal features of the shock initiation behavior. 15 refs., 2 figs.

39547 **(UCRL—96472) Changes in the particle size distribution of LX-17 samples induced by 5- to 8-GPa planar shock waves.** Bloom, G.; Honodel, C.; Lee, R.; Von Holle, W.; Weingart, R.; Duncan, A. (Lawrence Livermore National Lab., CA (USA); Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jun 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—37). NTIS, PC A02. File Number DE87012630.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Samples of LX-17 explosive were shocked to 3.5, 5.0, 5.7, 6.5, 9.4, and 10.6 GPa by the impact of thin flyer plates accelerated by an electric gun. The samples were held in a fixture designed to allow recovery of the shocked specimens. The specimen shocked to 10.6 GPa reacted strongly enough to pulverize, but not burn the sample; the other specimens were recovered intact. Particle size analysis performed on the recovered samples after the binder was removed by a solvent showed a reduction in mean particle diameter with increasing shock pressure.

39548 **Semiconductor bridge: A plasma generator for the ignition of explosives.** Benson, D.A.; Larsen, M.E.; Renlund, A.M.; Trott, W.M.; Bickes R.W. Jr. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 62: No. 5, 1622-1632(1 Sep 1987). Contract AC04-76DP00789.

Small metal bridgewires are commonly used to ignite energetic powders such as pyrotechnics, propellants, and primary or secondary explosives. In this paper we describe a new means for igniting explosive materials using a semiconductor bridge (SCB). When driven with a short (20 μs), low-energy pulse (less than 3.5 mJ), the SCB produces a hot plasma that ignites explosives. The SCB, a heavily n-doped silicon film, typically 100 μm long by 380 μm wide by 2 μm thick, is 30 times smaller in volume than a conventional bridgewire. SCB devices produce a usable explosive output in a few tens of microseconds and operate at one-tenth the input energy of metal bridgewires. In spite of the low energies for ignition, SCB devices are explosively safe. We describe SCB processing and experiments evaluating SCB operation. Also discussed are the SCB vaporization process, plasma formation, optical spectra from the discharge, heat transfer mechanisms from the SCB to the explosive powders, and SCB device applications.

39549 **Carbon clustering in detonations.** Shaw, M.S.; Johnson, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 62: No. 5, 2080-2085(1 Sep 1987).

The clustering of carbon in the detonation regime is studied with the assumption of a diffusion-limited clustering process. The diffusion constants are determined from modified Enskog theory and the Stokes—Einstein relation. With the size dependence of the cluster energy treated with a surface term, the energy difference between clusters and bulk carbon has an asymptotic time dependence of t^{-1}/sup //^{3}. That is, for any given time it takes 1000 times as long to release the next 90% of the carbon energy. This leads to a very slow "reaction rate" which can couple to the reaction zone to produce nonideal time-dependent detonations on the scale of microseconds and centimeters. In addition, any "bottleneck" in the clustering process due to a sticking coefficient of less than one leads to a temporary delay in energy release that persists out to times several orders of magnitude larger than the time scale of the initial effect of the "bottleneck."

4502 Nuclear

REFER ALSO TO CITATION(S) 39296, 39636

39550 **(AD-A—179973/3/XAB) Atmospheric effects of soot resulting from a nuclear conflict. Technical report, 11 June 1984-11 February 1985.** Endal, A.S. (Applied Research Corp., Landover, MD (USA)). 20 Mar 1985. 48p. (ARC—85-146). NTIS, PC A03/MF A01.

The effect of a sunlight-absorbing, high-altitude cloud layer on meteorological conditions near the earth's surface is investigated. If the soot remains in the atmosphere for a few weeks or longer, reduction of sunlight penetrating to the ground can lead to cooling of the lower troposphere. Atmospheric response to the sunlight reduction is simulated using a two-dimensional energy-balance model with diffusive energy transport. Severity and duration of the surface cooling are computed as functions of: (1) the time of year at which the soot is injected; (2) the latitudinal distribution of the soot layer; (3) the infrared absorptance of the soot particles,; (4) the rate of soot-removal (scavengaging) Global climate models assume that the smoke from urban fires is spread uniformly on synoptic scales within a few days after initial injection, and that microscale and mesocale processes do not break up or remove the soot layer. Global climate models assume that the smoke from urban fires is spread uniformly on synoptic scales within a few days after initial injection, and that microscale and mesocale processes do not break up or remove the soot layer. A heuristic analysis indicates that a horizontally uniform and optically thick soot layer is thermally unstable and will break up into long vertical filaments. This process may significantly change the mean optical properties of the cloud layer and thus alter the synoptic and planetary scale effects of the soot injection.

39551 **(AD-A—995463/7/XAB) Operation Sandstone. Scientific director's report of atomic weapon tests at Eniwetok, 1948. Annex 12. Parts 1 and 2. Biological and animal container studies (Service Test Number 7). Sandstone report No. 33.** (Cornell Univ., Ithaca, NY (USA). Dept. of Botany). 1948. 86p. NTIS, PC A05/MF A01.

39552 **(AD-A—995466/0/XAB) Operation Crossroads. Test of target airplane, Model TBM-3E, Serial Number 69169.** (Naval Air Material Center, Philadelphia, PA (USA). Aeronautical Materials Lab.). 25 Apr 1950. 157p. (NAMC-AML-AE—540001). NTIS, PC A08/MF A01.

39553 **(LA-UR—87-1935) EMP [electromagnetic pulse] representational tools for personal workstations.** Riley, A.; Shafer, D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-870778—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011785.

From NATO/SHAPE EMP protection technical symposium; Brussels, Belgium (13 Jul 1987).

The ability to rapidly provide a visual representation of a problem set, its accompanying environment, and the variables that directly impact the analysis is of enormous value to the weapons analyst. Parametric, first-principle tools are directly and immediately usable by the analyst to represent the systems under investigation and the effects on those systems by the weapons under analysis. The three tools described, GEOREP, 3-AXIS, and G RANGE, provide these visual, analytic tools directly to the analyst on personal computer workstations. The simplicity and rapidity with which these tools may be used are especially beneficial to weapons analysts dealing with complex phenomena such as EMP. The potential flexibility of these representational tools is shown through examples of notional weapons applications. Use of GEOREP, 3-AXIS, and G RANGE, which augment, rather than supplant, complex weapons effects physics codes, can help provide the necessary, cost-effective guidance for making decisions on detailed case studies.

39554 **(UCID—21079) Analysis of downhole canister alignment based on historical data.** O'Neal, W.C. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1987. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011913.

The purpose of the alignment project is to study, understand and control diagnostics canister deflection (misalignment) which occurs during the stemming of underground nuclear test hardware. A computer database containing historical engineering information was prepared and analyzed as part of a project to study, understand, and control downhole misalignment. The misalignment is a result of canister deflection during the stemming of underground nuclear test hardware. The results of an analysis, which consisted of comparing parameters individually to deflection, indicated that a number of borehole and canister geometry parameters had some re-

lationship to misalignment: borehole slope adjacent to canisters; depth of burial; borehole washouts in the canister region; the clearance between boreholes and canisters; the length of open framework in the canisters; the weight of prestemming placed in canisters (inverse). Several of these parameters reflect asymmetries in the borehole and position of the canisters. There is also an indication that prestemming doors and/or prestemming reduces deflection. This may be a result of significantly increased canister stiffness. 20 figs.

39555 **Yields of US and Soviet nuclear tests.** Evernden, J.F.; Marsh, G.E. (US Geological Survey, Menlo Park, California). *Physics Today;* **40**: No. 8, 36-55(Aug 1987).

Failure to account properly for geological and seismological differences between the US and Soviet test sites has led to overestimates of the yields of Soviet tests and to incorrect claims of Soviet cheating on the treaty limit of 150 kilotons.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 39176, 39591, 39728

39556 (INIS-mf—10632, pp 215) **Identification of underground nuclear explosions with the aid of wave-number spectra.** Hanka, W. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

39557 (INIS-mf—10632, pp 216) **Discrimination between nuclear weapons tests and earthquakes by means of particle motion diagrams of GRF wide-band data.** Krueger, F. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

39558 (INIS-mf—10632, pp 217) **Derivation of site-specific characteristics of underground nuclear explosions: Charge volume assessment.** Schlittenhardt, J. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

39559 (INIS-mf—10632, pp 218) **Cavern decoupling of nuclear explosions.** Mueller, G. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

39560 (INIS-mf—10632, pp 219) **Correlation of GRF-amplitudes with Shagan nuclear explosions.** Springer, D.L.; Bickert, B.; Harjes, H.P. 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245. (CONF-8604322—).

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 38881, 39601

39561 **(BNL—39865) Data integration for a scientific field experiment.** Benkovitz, C.M. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 10p. (CONF-8705147—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011302.

From Piecing the puzzle together: a conference on integrating data for decisionmaking; Washington, DC, USA (27 May 1987).

The Atmospheric Sciences Division at Brookhaven National Laboratory supports several projects involved in the development and application of data management techniques to compile, analyze and distribute scientific data sets that are the result of various multi-institutional experiments and data gathering projects. This paper will describe the data coordination function needed for one such experiment, the Cross Appalachian Tracer Experiment, which took place in September of 1983. The data needed for experiment planning had to be obtained and analyzed; the data produced during the field period by experiment participants had to be integrated with additional data sets produced outside of CAPTEX so that post experiment analyses could be conducted. Problems presented by the integration of diverse data sets flowing from multiple sources can be divided into problems requiring proper "people interfacing" and problems that can be solved via the use of computerized techniques. The degree of data integration given each CAPTEX data set was governed by its ultimate use and by the share of total resources available for the task. In this paper the solutions adopted for different data sets for both types of problems will be described. The resulting data sets are available to the scientific community at large.

39562 **(GKSS—86/E/51) Discrete solution of the anelastic equations of mesoscale modelling.** Bernard, R.S. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87770162.

A method is proposed for the discrete solution of the incompressible Navier-Stokes equations, using curvilinear coordinates to facilitate calculations with variable topography. The continuity and momentum equations are solved interactively in each phase of a predictor-corrector scheme derived from MacCormack's method. The algorithm is designed for mesoscale modelling with open boundaries in two and three dimensions, as well as for other applications. Computational results are presented for Boussinesq flow in two dimensions.

39563 **(Juel—2098) Description of a one-dimensional model for atmospheric chemistry.** Roeth, E.P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie). Nov 1986. 172p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87770203.

The purpose of the one-dimensional model presented here is to describe the chemical behaviour and the concentration profiles of atmospheric gases. All relevant components identified up to now in the atmosphere as well as those which must necessarily be there, are included alltogether about fifty different species. The model developed at the Kernforschungsanlage Juelich (KFA), is designed to support the field experiments done by the Institute for Atmospheric Chemistry of the KFA. Therefore great emphasis was laid to build a program readable for non-modellers, too. As our model is restricted to consider only the mass continuity equation, the other fundamental laws have to be taken into account via parameters, which are kept constant during one run of the program. This model description addresses mainly the expert, whom we want to explain how we are solving the special problems of our field. Therefore the algorithms are explained in full detail and an extended appendix is added. The first chapters, however, introduce the general aspects of

atmospheric modelling and the philosophy behind our model especially.

39564 **(KFK—4167) Measuring activities of the TULLA-experiment (field phase report).** Vogt, S.; Fiedler, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung). Feb 1987. 146p. NTIS (US Sales Only), PC A07. File Number DE87770211.

In order to improve our knowledge about the transport and chemical conversion of airborne pollutants in areas of several hundred kilometres sidelength, a field experiment was carried out in the Federal State of Baden-Wuerttemberg in March 1985. The objective of the experiment required a simultaneous registration of the timely and spatial distribution of the emissions, the relevant meteorological parameters for the transport, the chemical reaction rates as well as the timely and spatial distribution of the immissions in a three-dimensional framework. All measuring activities during TULLA are described in the report. No results are given, but the course of the experiment and the measurements that were carried out, are reported.

39565 **(NP—7770143) Comparison of the results of different interregional air pollution models. Final report.** Klug, W.; Goemer, D.; Luepkes, C. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Meteorologie; Umweltbundesamt, Berlin (Germany, F.R.)). Jul 1985. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770143.

The results of episode models and long term models were compared with one another and with measured data. Data for three different episodes in the years 1979, 1980 and 1981 were used for the comparison of the results of the episode models. The data for the comparison of the results of the long term models are based on the EMEP emission register for 1978 and on climatological data. The aim of the investigation is to be able to estimate the capacity of the model examined with regard to air cleanliness problems.

39566 **(NP—7770144) Comparison between long term interregional air pollution models. Appendix 2.** Klug, W.; Luepkes, C. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Meteorologie; Umweltbundesamt, Berlin (Germany, F.R.)). Jul 1985. 176p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87770144.

The results of long term air pollution models have been compared considering also observed immission data. The data for the comparison of the long term models is based on the EMEP emission grid for 1978 and on climatological data. The aim of the work was to study the performance of air pollution models. With 23 refs., 22 tabs., 96 figs.

39567 **Recent temperature changes during overcast and clear skies in the United States.** Karl, T.R.; Kukla, G.; Gavin, J. (National Climatic Data Center, Asheville, NC 28801). *Journal of Applied Meteorology;* **26**: No. 6, 698-711(Jun 1987).

A network of 14 nonurban stations was used as a first step toward understanding the character of changes of daily temperature between 1948 and 1983 across the United States. Overall, in the eastern two-thirds of the country more stations tend to reflect statistically significant cooler weather than would be expected due to chance alone. In the western one-third of the country the opposite is found. Despite the cooling in the east, air masses with comparable characteristics (dewpoints, cloud cover) affecting these stations have warmed. This finding is in qualitative agreement with the expected impact of rising concentrations of greenhouse gases.

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REFER ALSO TO CITATION(S) 38426, 38490, 38501, 38692, 38798, 38799, 38802, 38803, 39013, 39015, 39022, 39058, 39108, 39299, 39472, 39565, 39566, 39616, 39697, 39708, 39709

39568 **(AD-A—179817/2/XAB) Evaluation of the LOWTRAN 6 Navy maritime aerosol model using 8- to 12-micrometer sky radiances. Research report, October 1985-September 1986.** Hughes, H.G. (Naval Ocean Systems Center, San Diego, CA (USA)). Oct 1986. 19p. (NOSC/TD—1036). NTIS, PC A02/MF A01.

Measurements of infrared (8-12 micrometers) sky radiances over the ocean are compared with those calculated by LOWTRAN 6 by means of the Maritime Aerosol Model along with simultaneously measured (radiosonde) meteorological parameters and atmospheric radon concentrations. For a low wind-speed condition, the measured and calculated radiances agreed within 2% at the optical horizon. However, during moderate wind-speed conditions, the current wind-speed component of the aerosol model had to be lowered by factors near 20 in order to produce agreement of the calculated and measured radiances. The adjusted model is then found to agree closely with published results of large-particle-size distribution measurements in the North Atlantic.

39569 **(ANL/EES-TM—328) Uncertainty data base for emissions-estimation parameters: Interim report.** Chun, K.C. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Mar 1987. Contract W-31109-ENG-38. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011823.

This report presents the findings of a literature review on uncertainties associated with emissions-estimation parameters and emissions data, analyzes various types of errors and other factors that cause uncertainties in emissions-estimation parameters, and presents the interim results of an effort to compile and develop an uncertainty data base for several of these parameters. Illustrative, preliminary emissions uncertainty estimates are also provided, based on these parameter uncertainties and approximate mathematical procedures.

39570 **(BMFT-FB-T—86-107) Alternative fuel from domestic refuse. Final report.** Liss, U.; Vollmer, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Mannesmann Verfahrens- und Umwelttechnik G.m.b.H., Herne (Germany, F.R.)). Dec 1986. 247p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770136.

The most commonly known fuels from household waste (BRAM) are available either in loose or briquette form. The powder form envisaged in this project is an exception to this. As at the beginning of the project there was no precise information as to the technical possibilities of pulverization of the light fraction of household refuse, the preliminary investigations clarified the questions of cellulose embrittelement and comminution. Based on an American process technology, a fuel in powder form, ECO-FUEL was then produced from German household refuse at engineering college level. This process was then optimized by suitable development, both as regards process technology and specific fuel aspects. As regards harmful substances in the fuel, the chlorine content in particular was substantially reduced with this process. Trial burning over several weeks in a dust furnace proved the basic applicability of this alternative fuel. With 13 refs., 37 tabs., 55 figs.

39571 **(CONF-870853—3-Ext.-Abst.) Air velocities inside domestic environments: An important parameter for passive monitoring.** Matthews, T.G.; Thompson, C.V.; Wilson, D.L.; Hawthorne, A.R.; Mage, D.T. (Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Research Triangle Park, NC (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007732.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Air velocities have been measured in the master bedroom, kitchen, and basement of six occupied homes plus the dining/living room area of one unoccupied house. Median air velocities of 5.3 and 12.4 cm/s in the occupied and unoccupied houses raise concern that inadequate air movement may sometimes exist for accurate passive monitoring of pollutant vapors. Central-air circulation systems had a variable impact on air velocity. Median velocities increased from 5.8 to 6.2, 3.2 to 5.7, 1.5 to 8.1, and 4.4 to 15.5 in three occupied and one unoccupied houses, respectively. Median velocities of 4.2, 4.3, and 10.2 cm/s in the master bedroom, basement, and kitchen, respectively, are consistent with increased occupant activities and use of ceiling and/or exhaust fans in or near the kitchen.

39572 **(CONF-8505122—4) Turbulent group reaction model of spray dryer.** Ma, H.K.; Huang, H.S.; Chiu, H.H. (EER Co., Irvine, CA (USA). Poseidon Research; Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA). Dept. of Mechanical Engineering). [1987]. Contract W-31109-ENG-38. 10p. NTIS, PC A02. File Number DE87011428.

From EPES '85 - energy, power and environmental systems international conference; Santa Barbara, CA, USA (29 May 1985).

A turbulent group reaction model consisting of several submodels was developed for the prediction of SO_2 removal efficiency in spray dryers. Mathematical models are developed on the basis of Eulerian-type turbulent Navier-Stokes equations for both gas and condensed phases with interphase transport considerations. The group reaction number, G, is defined as the ratio of the SO_2 absorption rate to a reference convective mass flux. This number represents the fraction of SO_2 absorbed into the lime slurry. The model is incorporated into a computer code which permits the investigation of spray dryer design concepts and operating conditions. Hence, it provides a theoretical basis for spray dryer performance optimization and scale-up. This investigation can be a practical guide to achieve high SO_2 removal efficiency in a spray dryer.

39573 (CONF-8610274—Absts., pp 14) **Nonrestricted off-gas components.** Schindlbauer, H.; Handig, J. 1986. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752238.

From Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW); Leoben, Austria (23 Oct 1986).

39574 **(CONF-8705149—1) Comparison of three aerosol sampling techniques and the differences in the nitrate determined by each.** Johnson, S.A.; Kumar, R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011456.

From Symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

Ambient aerosol samples were collected simultaneously with three different methods, one a size fractionated impactor sampler and two filter samplers. Infrared spectroscopy was used to analyze the collected aerosol using attenuated total internal reflection for the impactor samples and direct transmission through ultra-thin teflon membrane filters for the filter samples. All samples were analyzed as soon as possible after collection; some were reanalyzed after being stored in closed petri dishes for up to 10 days. A major purpose of the study was to evaluate the neutralization of acidic sulfate aerosols after sample collection by the filtration techniques. No acidic sulfate was found in any of the samples collected during the field study. However, significant differences were observed in the nitrate content of the samples collected by the different samplers. Also, in several samples collected with the ATR impactor the nitrate content decreased upon storage. In some cases the nitrate absorbance bands diminished to zero; in other cases the nitrate initially decreased and then remained stable; in yet another case, a high level of nitrate persisted over several days. The results indicate that two different types of nitrate compounds were present in the samples, one more "volatile" than the other, although the infrared spectra were consistent with both of them being ammonium nitrate.

39575 **(DOE/ER/60372—2) Recent climate change in North America and CO_2: Search in stratified daily data: Progress report for period 4/31/86-4/31/87.** Kukla, G.J. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). May 1987. Contract FG02-85ER60372. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012411.

The objectives were: (1) to identify the CO_2 fingerprint in stratified daily weather records available since 1900; (2) to characterize recent climate fluctuations in North America in terms of the changing frequency and distribution of various daily weather types; and (3) to determine empirical relationships of humidity, cloud cover, wind, precipitation, snow, etc., to surface air temperature and to use this information for improvements of the input to climate models. The results indicate: (1) a relative warming of urban sites with respect to the countryside; (2) a significant decrease of the diurnal temperature range has taken place; (3) an increase of minimum temperatures under overcast skies; and (4) an increase in both minima and maxima under clear skies. (ACR)

39576 **(GKSS—86/E/39) Wet and dry deposition of heavy metals.** Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 10p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-09994.

Automatic precipitation samplers according to the VDI guideline 3870 have proved well in the determination of wet deposition of heavy metals. As a basis for dry deposition studies, the concentration method involving the application of impactors with a high air through-put rate allows to determine atmospheric heavy-metal concentrations fractionated according particle size. Total reflexion X-ray fluorescence analysis is used as a multi-element method in both cases.

39577 **(GKSS—86/E/58) Raman lidar for the measurement of height profiles of water vapor and carbon dioxide.** Weitkamp, C.; Riebesell, M.; Voss, E.; Lahmann, W.; Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1986. 18p. (CONF-8608189—1). NTIS, PC E07; Available from NTIS as TIB/B87-06476.

From Alfred-Wegener conference on ground-based remote-sensing techniques for the troposphere; Hamburg, F.R. Germany (25 Aug 1986).

The paper describes a ground-based lidar for the height-resolved determination of tropospheric water vapor concentrations. The measurement is based on the detection of backscattered Raman radiation following the transmission of ultraviolet light from a xenon chloride excimer laser. Other essential components of the lidar are a 0.4-m transmitter and 0.8-m receiver optics and a high-resolution, high-luminosity echelle-type polychromator. The system will also be used to assess the applicability of Raman lidar to the study of distributions and exchange processes of atmospheric carbon dioxide.

39578 **(GSF—42/86) Environmental models and computer aided decision supports for the comparative assessment and priority setting among environmental chemicals.** Rohleder, H.; Matthies, M.; Benz, J.; Brueggemann, R.; Muenzer, B.; Trenkle, R.; Voigt, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1986. 302p. (In German). NTIS (US Sales Only), PC A14. File Number DE87770208.

Mathematical models which consider the most relevant environmental transport and transformation processes, were developed for the description of the environmental fate of chemicals. Three models regarding the behaviour in soil, surface waters and lower troposphere together with another model which describes the exchange processes between these three media form the core of a system for exposure estimations. Two further models are available for special situations. With 45 refs., 39 tabs., 36 figs.

39579 **(GSF—43/86) Mackay's fugacity model with levels I to IV. Parameters, compartmentalisation, sensitivity.** Brueggemann, R. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1986. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770212.

Mackay's exposure model is a valuable aid in comparative exposure studies. It is well suited for hydrophobic, persistent substances but less well to other classes of substances. Important mechanisms are considered in a simplified manner, e.g. degradation reactions and sorption, and the available substrate-specific data are utilized efficiently. Beyond its direct range of applications, Mackay's model presents an important stimulus for a comparative evaluation of the exposure characteristics of chemical substances.

39580 **(GSF-BPT—11/86) Development of a continuous actinometer for aldehydes in air based on detection of the photochemically produced carbon monoxide. Final report.** Mueller, R.; Schurath, U. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Bonn Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). 1986. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770200.

A continuous actinometer has been developed which measures the photolysis frequencies of aldehydes in air at ambient pressure. It consists of a permeation system for the generation of typically 100 ppm aldehyde in purified synthetic air, a quartz tube for exposure, and a specific detector which measures the photoproducts CO and H/sub 2/ after their separation by GC. The diurnal variation of formaldehyde and acetaldehyde photolysis frequencies was measured during periods of fair weather in July/August 1984. The dependence of the photolysis frequencies on solar zenith angle could be approximated by a two-parameter function. Photolysis frequencies of aldehydes and of other trace gases are discussed with respect to radical formation in the lower troposphere. With 23 figs., 2 tabs., 23 refs.

39581 **(Juel-Spez—375) Stratospheric observations of long-lived trace gases at midlatitudes 1982-1985. Data report.** Schmidt, U.; Jebsen, C.; Johnen, F.J.; Khedim, A.; Klein, E.; Knapska, D.; Kulessa, G.; Rudolph, J.; Schumacher, G.; Schunck, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie). Oct 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87770201.

Large air samples were collected using a balloon-borne cryogenic whole-air sampler, that is cooled with liquid neon. Various gaschromatographic techniques were employed to determine the mixing ratios of the following long-lived trace gases: CO/sub 2/, CH/sub 4/, CO, N/sub 2/O, CFCl/sub 3/, CF/sub 2/Cl/sub 2/, CH/sub 3/Cl, CH/sub 3/CCl/sub 3/, CCl/sub 4/, C/sub 2/F/sub 3/Cl/sub 3/. This report presents the data from seven balloon flights that were performed at midlatitudes over Southern France (44/sup 0/C) in the time period from 1982-1985. This report is intended as a data report. It includes no interpretation or discussion and the measurements are not compared to any other data set.

39582 **(NP—7752615) Sanasilva report on forest decline, 1986.** (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf). Nov 1986. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752615.

The report is to serve as a decision aid for the responsible authorities. The main part contains information on the status of the Swiss forests. In addition, there are contributions on 'Disturbances of forest ecosystems as a result of emissions' and 'Consequences of forest decline'.

39583 **(NP—7770156) Damage to buildings from contamination of the air. A state-of-the-art report.** Oswald, R.; Rogier, D.; Leven, T.; Lindt, M.; Schnapauff, V. (Bundesministerium fuer Raumordnung, Bauwesen und Staedtebau, Bonn (Germany, F.R.)). 1985. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770156.

This report describes the present state of knowledge of the effects of impurities in the air on the outside of tall buildings. The report describes in detail our knowledge of the behaviour of different materials used on the outside of buildings and shows that the resistance to impurities in the air is sometimes quite different. The consequential damage due to contamination of the air can be considerably reduced by suitable design, choice of material and maintenance.

39584 **(NP—7770204) Plastics as air pollution indicators. Results of exposure experiments.** Schliep, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Verfahrenstechnik und Dampfkesselwesen). 1986. 126p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770204.

Six different elastomers were investigated with a view to their applicability as air pollution indicators. The elastomers were exposed to different types of air pollution at different sites. In the experiments, caoutchouc standard shoulder rods were held by special supports. Changes in the test pieces were determined by comparing the mechanical values. The experimental conditions and results are described and presented.

39585 **(PNL—6238) Key statistics related to CO_2 emissions: Significant contributing countries.** Kellogg, M.A.; Edmonds, J.A.; Scott, M.J.; Pomykala, J.S. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012501.

This country selection task report describes and applies a methodology for identifying a set of countries responsible for significant present and anticipated future emissions of CO_2 and other radiatively important gases (RIGs). The identification of countries responsible for CO_2 and other RIGs emissions will help determine to what extent a select number of countries might be capable of influencing future emissions. Once identified, those countries could potentially exercise cooperative collective control of global emissions and thus mitigate the associated adverse affects of those emissions. The methodology developed consists of two approaches: the resource approach and the emissions approach. While conceptually very different, both approaches yield the same fundamental conclusion. The core of any international initiative to control global emissions must include three key countries: the US, USSR, and the People's Republic of China. It was also determined that broader control can be achieved through the inclusion of sixteen additional countries with significant contributions to worldwide emissions.

39586 **Adsorption of sulfur dioxide from combustion gases on a regenerable molecular sieve.** Christwell, C.; Gollakota, S. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 1, 505-512(Apr 1987). (CONF-870410—). Contract W-7405-ENG-82.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A new molecular sieve adsorption process is being developed for removal and recovery of sulfur dioxide from combustion gases. Desirable features of the process include: SO/sub 2/ accumulation is efficient at temperatures ranging from 50°C to >800°C, at pressures ranging from 1 to 30 atmospheres, and at SO/sub 2/ concentrations ranging from 500 ppm to 100%. Rates of adsorption are high, bed depth requirements are low, and back pressures are negligible. Sulfur dioxide is selectively adsorbed in the presence of major and trace constituents of combustion gases. Preliminary evaluation indicate the process will be competitive in costs with wet-lime scrubbing, but also it will be applicable to hot combustion gases that cannot be desulfurized by existing methods.

39587 **A prototype beryllium monitoring instrument based on the laser-induced breakdown spectroscopic technique.** Cremers, D.A.; Archuleta, F.L.; Romero, D.J.; Basinger, R.W.; Griggs, E. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp WA3.1-WA3.2 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The LIBS (Laser-Induced Breakdown Spectroscopy) method is one form of atomic emission spectroscopy in which the excitation source is a laser spark plasma. Unlike most other forms of emission spectroscopy, however, no time-consuming sample preparation is necessary because the spark can completely vaporize beryllium particles less than 10 microns in diameter. In the prototype device, the laser sparks are generated by focusing pulses from a small portable Q-switched Nd:YAG laser (10 Hz, 150 mJ/pulse) on the surface of a filter or directly in air. The prototype instrument is currently undergoing testing before delivery to a beryllium ore processing plant for on-site evaluation. Preliminary results indicate that detection limits for beryllium in both the air sampling and filter analysis modes will be within a factor of 10 of the limits obtained in the laboratory-based experiments which are 0.6 parts-per-billion (w/w) beryllium/air with a signal-to-noise ratio (SNR) of 2 and 0.45 ng/cm of beryllium (SNR=6), respectively. For comparison, the OSHA limit for 8-hour exposure is 1.8 parts-per-billion. Therefore, direct air sampling will be mainly useful to warn of beryllium concentrations in an emergency situation. On the other hand, the sensitivity of the filter analysis method is such that if air is passed through the filter at the rate of 40 liters/minute typically used for air sampling, then only 27 seconds will be required to collect a measurable beryllium concentration. Other factors such as long-term stability of the optics and reliability of components, especially the laser, are being evaluated.

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REFER ALSO TO CITATION(S) 38623, 38665, 38891, 38892, 38909, 38911, 38948, 38982, 39058, 39516, 39623, 39637, 39684, 40108

39588 **(DEMO—85/3) ADREA-I: a transient three dimensional transport code for atmospheric and other applications - some preliminary results.** Bartzis, G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Feb 1985. 30p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702432.

In this work a general description of the ADREA-I code is presented and some preliminary results are discussed. The ADREA-I is a transient three dimensional computer code aimed at transport analysis with particular emphasis on atmospheric dispersion under any realistic terrain conditions (complex or not) applicable to the planetary boundary layer in a distance extending up to a hundred kilometers or more. The complex geometry applications and the reasonable results obtained constitute a solid indication of the broad capability of the code.

39589 **(EPA—520/5-87-005) EERF [Eastern Environmental Radiation Facility] standard operating procedures for radon-222 measurement using charcoal canisters.** Gray, D.J.; Windham, S.T. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Jun 1987. 34p. NTIS, PC A03/MF A01. File Number TI87900843.

The passive nature of activated charcoal allows both adsorption and desorption, and, in addition, the adsorbed radon undergoes radioactive decay during the exposure period. Therefore, the canister cannot uniformly integrate over the entire exposure period. However, the canisters can be calibrated to yield precise results for radon concentrations in structures during the deployment period of 48 hours used by the US Environmental Protection Agency (EPA).

39590 **(EUR—10243) Methods for assessing the off-site radiological consequences of nuclear accidents.** (Commission of the European Communities, Luxembourg). 1986. 232p. Commission of the European Communities, Luxembourg.

The report has been prepared within the context of the CEC Radiation Protection Programme 1980-84 under the contract with Kernforschungszentrum Karlsruhe (KfK) in the Federal Republic of Germany and the National Radiological Protection Board in the United Kingdom. The aim of the study was to review and improve the nuclear accident consequence assessment methods currently used in the Member States. The report presents an overview of the field of accident consequence assessment as seen by the Commission and by the responsible staff of both contractors. To aid readers of this report who are unfamiliar with accident consequence analysis (ACA), it has been divided into two sections. Part A reflects the significance of ACA in probabilistic risk studies and discusses the application of ACA in areas such as the estimate of the risk presented by a nuclear installation, the sitting of nuclear facilities, emergency planning and design criteria. Part B is intended for those interested in a more detailed discussion and for workers familiar with aspects of the models used. It gives a description of the current status of ACA methodologies, identifies future needs and developments and includes illustrative applications.

39591 **(MISU-CM—68) On the design of a global detection system for airborne radioactivity.** Rodhe, H.; Hamrud, M. (Stockholm Univ. (Sweden). Dept. of Meteorology). 5 Dec 1984. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751948.

Requirements are investigated for a global network of air sampling stations to have a reasonable efficiency for detecting emissions to the atmosphere of radioactive material anywhere on Earth. It is found that some 50 stations should be enough to detect within 15 days and with a probability of at least 25 percent a nuclear explosion with a fission yield larger than or equal to 1 kt. If the probability limit is set at 90 percent, a substantially greater number of stations is required.

39592 (NIRS-RSD—72, pp 5-9) **Strontium-90 and cesium-137 in rain and dry fallout (for domestic program) (from January 1985 to July 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cesium-137 in rain and dry fallout (for domestic program) made at various places across Japan during the period from Jan. to July in 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydroxide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

39593 (NIRS-RSD—72, pp 10-12) **Strontium-90 and cesium-137 in rain and dry fallout (for WHO program) (from January 1985 to July 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cesium-137 in rain and dry fallout (for WHO program) made at various places across Japan during the period from Jan. to July in 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydrox-

ide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

39594 (NIRS-RSD—72, pp 13-14) **Strontium-90 and cesium-137 in airborne dust (from October 1984 to June 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cesium-137 in airborne dust made at various places across Japan during the period from Oct. 1984 to June 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydroxide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

39595 (RFP—4036, pp 42-48) **Resuspension parameters for TRAC dispersion model.** Langer, G. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

Resuspension factors for the wind erosion of soil contaminated with plutonium are necessary to run the Rocky Flats Plant Terrain Responsive Atmospheric Code (TRAC). The model predicts the dispersion and resulting population dose due to accidental plutonium releases.

39596 (TVA/PUB—87/14) **Environmental radioactivity levels, Bellefonte Nuclear Plant: Annual report, 1986.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Apr 1986. 27p. NTIS, PC A03/MF A01. File Number DE87900849.

The Bellefonte Nuclear Plant (BLN), being constructed by the Tennessee Valley Authority, is located in Jackson County, Alabama. The plant will consist of two pressurized water reactors; each unit is rated at 3620 MWt and 1271 MWe. Fuel load in unit 1 is scheduled for no earlier than 1993. A preoperational environmental radiological monitoring program was implemented in August 1978 and continued through 1983. This program had the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. Because of the extended delay in fuel loading, the sampling program was substantially reduced for 1984 and 1985 with further reductions for 1986. This report presents the results obtained from the program conducted during 1986. Since BLN has not achieved criticality, there has been no contribution of radioactivity to the environment from the operation of the plant. The levels of radioactivity being reported in this document are due to natural background radiation, fallout from nuclear weapons testing, or other nuclear operations in the region.

39597 (TVA/PUB—87/15) **Environmental radioactivity levels, Browns Ferry Nuclear Plant: Annual report, 1986.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Apr 1986. 58p. NTIS, PC A04/MF A01. File Number DE87900848.

The report presents data gathered during radiological monitoring program conducted in the environs of the Browns Ferry Nuclear Plant. Dose estimates were made from concentrations of radioactivity found in samples of media including air, milk, food products, drinking water, and fish. Inhalation and ingestion doses estimated for persons at the indicator locations were essentially identical to those determined for persons at control locations. Greater than 95% of those doses were contributed by the naturally occurring K-40 and by Sr-90 and Cs-137 which are long-lived radioisotopes found in fallout from nuclear weapons testing. Increased levels of I-131 were reported in air, milk, and rainwater following the accident at the Chernobyl nuclear power station. In addition, Ru-103, Cs-137, and Cs-134 were identified in air particulates, and traces of Ru-103 were found in rainwater. (ACR)

39598 (TVA/PUB—87/16) **Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1986.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). May 1986. 60p. NTIS, PC A04/MF A01. File Number DE87900847.

The Watts Bar Nuclear Plant (WBN) is located in Rhea County, Tennessee, bounded on the east by Chickamauga Reservoir. A preoperational environmental radiological monitoring program was implemented in December 1976. This program has the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1986. Since WBN has not achieved criticality, there has been no contribution of radioactivity from the plant to the environment. The levels of radioactivity being reported in this document are due to natural background radiation, fallout from nuclear weapons testing, fallout from the Chernobyl nuclear power station accident, or other nuclear operations in the area.

39599 (TVA/PUB—87/17) **Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1986.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Apr 1986. 58p. NTIS, PC A04. File Number DE87900846.

The Sequoyah Nuclear Plant (SQN) is located in Hamilton County, Tennessee, bounded on the east by Chickamauga Reservoir. This report describes the environmental radiological monitoring conducted in 1986. The preoperational environmental radiological monitoring program established a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. However, seasonal, yearly, and random variations in the data were observed. In order to determine the potential increases in environmental radioactivity levels caused by the plant, comparisons were made between data for indicator stations (those near the plant) and control stations (those remote from the plant) in conjunction with comparisons with preoperational data. Dose estimates were made from concentrations of radioactivity found in samples of environmental media such as air, milk, drinking water, and fish. Doses estimated for persons at the indicator locations were similar to those determined for persons at control locations. Greater than 95 percent of those doses were contributed by the naturally occurring radionuclide K-40, and by Sr-90, and Cs-137 which are long-lived radioisotopes found in fallout from nuclear weapons testing. Increased levels of I-131 were reported in samples of air, milk, and rainwater following the Chernobyl nuclear power station accident. In addition, Ru-103, Cs-137, and Cs-134 were identified in air particulate filters.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 38812

5005 Site Resource And Use Studies

39600 (RFP—4036, pp 9-14) **Rocky Flats Plant weather forecasting program.** Hammer, R.J. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

The objective of this program is to establish rapid and dependable site-specific forecasting. Through WSI Corporation com-

puter links, weather maps are usually available within 10 to 15 min of the data observation time. Future plans to enhance the program include developing a detailed climatological database and establishing a weather and ground condition observation program.

39601 (RFP—4036, pp 14-16) **Rocky Flats Plant meteorological data quality control program.** Hammer, R.J. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

This program established quality control measures to assure the integrity of meteorological data. A software program was written to flag questionable data.

5006 Regulations

REFER ALSO TO CITATION(S) 38490

39602 (CONF-8704164—1) **Environmental audits: What they are and why they are needed.** Sigal, L.L.; Eddlemon, G.K. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008596.

From 15. environmental symposium; Long Beach, CA, USA (28 Apr 1987).

The objectives of this paper are to describe environmental auditing and its benefits, to outline elements common to most environmental auditing programs, and to present three cases that show operations-, compliance-, and management-related variations on the environmental auditing theme. In addition, the recent EPA policy on environmental auditing is described and the problem of confidentiality is discussed.

39603 (INIS-mf—10613) **Survey of environment related monitoring programmes of international organizations and their contribution to international monitoring programmes. Improvement and harmonisation of environmental measurement. Preprint.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Dec 1986. 39p. NTIS, PC E07; Available from NTIS as TIB/B87-06103.

The report is a summary of environment-related monitoring programmes of international governmental organizations and their contribution to international monitoring programmes. it presents the situation as of November 1986: This survey has been prepared by a consultant for the Secretariat as a background document for the second meeting of the Environment Experts, Economic Summit in Munich, November 1986. It serves information purposes only. No claim for completeness is intended. This report may also prove to be helpful for administrators and the scientific community as regards gaining knowledge on present arrangements, approaches and environmental activities in the framework of international organizations. In this light, the present report could facilitate communication and progress in solving pressing environmental problems on the international level.

39604 (NP—7752612) **Limiting values of immission for air pollutants. A comprehensive presentation.** (Bundesamt fuer Umweltschutz, Bern (Switzerland)). Jun 1986. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752612.

The brochure points out the importance of limiting values of immission and the criteria for laying down such limiting values. Furthermore the properties and effects of the most important air pollutants are discussed for which limiting values of immission are laid down in the clean-air ordinance. This publication provides a general comprehensive overview. It is supported by an extensive bibliography. Hints to some main works of reference used which are, in their turn, made up from numerous individual publications, are found in a bibliographic table as the end of the report.

39605 (NP—7770207) **Environmental research and environmental technology research program. First interim balance.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770207.

The first interim BMFT balance on ecological research documents the situation as such, practical measures and results of research investigating into the damage to forests and refers to atmospheric chemistry, ecotoxicology, soil and water pollution, environmental sampling etc. Ecological BMFT research specializes in concrete problems within environmental policies. Part two of the balance discusses environmental technologies for water pollution abatement, waste management and air pollution abatement as well as low-emission technologies and products along with their present state and situation, aims, research programs and financing. Research programs and financial assistance have brought about a multiform further development of the state of art. (HSCH).

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 39721, 39722, 39723, 39724

39606 (DOE/ER/60297—4) **Compensatory mortality in mule deer populations: Technical progress report.** White, G.C. (Colorado State Univ., Fort Collins (USA). Dept. of Fishery and Wildlife Biology). 15 Jul 1987. Contract FG02-85ER60297. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011825.

The hypothesis of compensatory mortality is critical to understanding population dynamics of wildlife species. This research tested for compensatory mortality in the juvenile (fawn) portion of a mule deer population. In the fall of 1986, 60 fawns were telemetered on both the control and treatment sites of the Little Hills study area. Thirteen adult females also were telemetered which, together with 31 telemetered adults already present, brought the total instrumented population to 164 at the onset of winter. Experimental manipulation to test for compensation in the population was successful, with 18% of the population on the treatment area (328 animals) removed. Line transect estimates of deer groups/ha were 0.12 +- 0.030 (D +- SE) for the control area and 0.14 +- 0.028 for the treatment area, giving 1727 individuals on the control area and 1490 on the treatment area. Thus the number of deer was measurably decreased on the treatment area by the removal operation.

39607 (DOE/ER/60470—T1) **Scientific accomplishments and future research: Annual technical progress report.** (Pennsylvania State Univ., University Park (USA)). [1987]. Contract FG02-86ER60470. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012044.

This research involves the study of ecosystem dynamics near Toolik Lake in the North Slope region of Alaska. The primary focus is to test new applications of remote sensing systems and advanced digital analysis techniques for studying hydrologic/ecologic interactions. The primary goals are to: (1) evaluate the feasibility of using advanced remote sensing and digital database processing techniques to identify and measure landscape components important in land disturbance processes, and (2) establish and quantify spatial interrelationships between landform geometry (i.e., elevation, slope, and slope aspect) and ecologically important features such as snow distribution, solar insolation, depth to active layer, and plant biomass. A multi-layered digital database has been developed for the area from black-and-white and color infrared aerial photographs in conjunction with field data and large-scale topographic maps. This high-resolution database presently has twelve layers representing various ecological and terrain-related attributes including elevation, slope, slope aspect, snow distribution (two separate dates), primary vegetation, secondary vegetation, tertiary vegetation, percent open water, landform, surface form, and terrain units.

39608 (INIS-BR—623) **Computerized tomography as a new method for studying the physics of water in soil.** Crestana, S. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). Aug 1985. 151p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702459.

In this thesis the authors present a new method for the investigation of water in soil physics using x-ray computed tomographic scanning. It is shown that the new method is in agreement with previous classical techniques such as γ-ray attenuation and gravimetric. It is also demonstrated that the method allows new approaches quantitative analysis of problems such as bi- and tridimensional dynamical studies as well as of heterogeneity in soil and water distributions. The authors apply the method to investigations of vertical infiltration of water in wet and compacted soil, simulation of drop irrigation and for preliminary studies of seed germination in situ. These applicatons would not be possible without these capabilities and advantages of this new method. Results complement those of Perovic et al and Hainsworth et al in that the authors have investigated experimentally the complete dependence of H. U. (Hounsfield Units) on dry bulk density, water content and energy. Finally some of the results obtained are repeated, using a non-medical X and γ-ray minitomograph of considerable simplicity which will open new possibilities for the application of the proposed method.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 38720, 39022, 39576, 39582, 39617, 39631, 39637, 39706, 39708

39609 **(AD-A—180117/4/XAB) Fate of selected organic pollutants during landfill-disposal operations. Final report, 3 DecEMBER 1984-11 JulY 1986.** Pohland, F.G.; Schaffer, T.R.; Yari, S.; Cross, W.H. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Mar 1987. 199p. (SCEGIT—86-108). NTIS, PC A09/MF A01.

The codisposal of selected organic priority pollutants with municipal refuse was investigated with four pilot-scale simulated landfill cells operated under the influence of single pass leaching or leachate recycle. The acid-formation and methane-fermentation phases of landfill stabilization were established and described in terms of routine analyses performed on leachate and gas samples for a variety of indicator parameters. During a 15-month period, little evidence of release of butanone, trichloroethane, phenol, pentachlorophenol, 4,6-dinitrocresol, di-n-butyl phthalate, 2,6-dinitrotoluene, 2,4-dinitrotoluene, phenanthrene, hexachloroethane, 2,4'dichlorobiphenyl, and hexachlorobiphenyl was obtained even after elution of as much as 20-bed volumes in the recycle cells. Moreover, patterns of microbially mediated conversion of substrate were not influenced by the presence of the organic priority pollutants and could be accelerated through leachate recycle. Assimilation of the organic priority pollutants throughout th e phase of landfill stabilization was ascribed to physical-chemical and biochemical attenuation and possible fractionation within the waste mass. Additional studies are indicated to further establish assimilative capacities for organic priority pollutants codisposed with municipal refuse in landfill-disposal sites.

39610 **(DOE/SR/10711—6) Influence of municipal sludge on elemental cycling and growth of loblolly pine: Final report for the period September 1, 1980 to December 31, 1985.** Wells, C.G.; McKee, W.H. Jr. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). 25 Dec 1985. Contract AI09-80SR10711. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012149.

Tree growth and environmental effects were evaluated for the application of a liquid anaerobic sludge, with a carbon/nitrogen ratio of 3:1, and a solid aerobic sludge, with a carbon/nitrogen ratio of 20:1, to loblolly pine at time of planting, and at ages 2, 8, and 28 years. The high nitrogen availability of the anaerobic sludge increased volume growth of the 8- and 28-year-old stands about 30 percent for the 4 years after application. Growth increase was not as great in the young stands. The aerobic sludge, low in available nitrogen as a result of a high carbon/nitrogen ratio, produced no significant increase in tree growth. Nitrate nitrogen concentration in soil solution at 1-meter depth exceeded the public health standards for potable water when the liquid anaerobic sludge was applied to supply 800 kg of nitrogen per hectare but not at the 400 kg rate except when applied at planting. Solid aerobic sludge applied at the rate of 630 kg of nitrogen per hectare did not increase soil nitrate concentrations and could be applied at higher rates. An increased leaching of soil calcium was found where liquid sludge was applied; however, there was no increase in toxic elements in the soil solution at the 1-meter soil depth. In the first year after application, the number of soil mesofauna were decreased by the liquid sludge and increased by the solid sludge, but populations began returning to nontreatment levels in the second year.

39611 **(FRNC-TH—2294) Transfer of hydrocarbon into water in saturated porous medium: effect of selective dissolving on contamination of underground water by petroleum products.** Ramanantsoa, B. (Strasbourg-1 Univ., 67 (France)). 1983. 226p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752658.

Influence of water circulation rate and pollution length on the transfer of soluble hydrocarbons in saturated porous media are examined. Hydrocarbon mixtures are analyzed by infrared absorption spectra. Oil leaching and retention are examined in sand column. A mathematical model is developed for a point source at different flow rates.

39612 (NP—7770140, pp 225-247) **Soil analysis programme No. 8810.526.01, Hamburg. Sub-report: Biochemical soil analysis.** Rastin, N.; Rosenplaenter, K.; Huettermann, A. 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

To verify the effect of acid rain on litter decomposition following tests were carried out in the environment of Hamburg: determination of biomass activity, determination of enzymae activities, determination of the desamination and nitridation capacity of soil microorganisms and the analysis of soluble phenols. The results were discussed and compared to other ecosystems.

39613 (NP—7770140, pp 263-285) **Symptoms of forest die-back.** Huettermann, A. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

The possible reasons and damaging factors for forest dieback are introduced and discussed with the final conclusion, that so far it was not possible to disprove the thesis, that soil acidification due to acid rain in the primary cause for forest decline.

39614 **(ORNL/TM—9838) Empirical relationships between watershed attributes and headwater lake chemistry in the Adirondack region.** Hunsaker, C.T.; Christensen, S.W.; Beauchamp, J.J.; Olson, R.J.; Turner, R.S.; Malanchuk, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011969.

This study focuses on the Adirondack region of New York and has two purposes: to (1) develop empirical models that can be used to assess the chemical status of lakes for which no chemistry data exist and (2) determine on a regional scale watershed attributes that account for variability in lake pH and acid-neutralizing capacity (ANC). Headwater lakes, rather than lakes linked to upstream lakes, were selected for initial analysis. Both bivariate (correlations and Wilcoxon and Kruskal-Wallis tests) and multivariate analyses were performed. Fifty-seven watershed attributes were selected as input variables to multiple linear regression and discriminant analysis. For model development ~200 lakes for which pH and ANC data exist were randomly subdivided into a specification and a verification data set. Several indices were used to select models for predicting lake pH (31 variables) and ANC (27 variables). Twenty-five variables are common to the pH and ANC models: four lake morphology, nine soil/geology, eight land cover, three disturbance, and one watershed aspect. An atmospheric input variable (H^+ or NO_3^-) explains the greatest amount of variation in the dependent variable (pH and ANC) for both models. The percentage of watershed in conifers is the next strongest predictor variable. For all headwater

lakes in the Adirondacks, ~60% of the lakes are estimated to have an ANC ≦50 μeq/L, and 40% of the lakes have a pH ≦5.5, levels believed to be detrimental to some fish species.

39615 **(PB—87-183695/XAB) Guidance manual on hazardous-waste land treatment closure/post-closure, 40 CFR Part 265. Final report.** Sims, R.; Sims, J. (Utah State Univ., Logan (USA). Dept. of Civil and Environmental Engineering). Apr 1987. 46p. NTIS, PC A03/MF A01.

The guidance manual addresses closure/post-closure of hazardous-waste land treatment (HWLT) units under 40 CFR Part 265 Subpart G and Section 265.280 of Subpart M. The manual specifically addresses five areas: (1) general information on HWLT and methods of closure; (2) objectives of closure and post-closure; (3) factors affecting closure and post-closure; (4) methods for addressing closure and post-closure based on migration potential; and (5) management during closure and post-closure.

39616 (UCRL—52000-87-5, pp 14-20) **GEOTOX: Simulating contaminant behavior and human exposure.** 1987. NTIS, PC A03/MF A01. File Number DE87010851.

In Energy and Technology Review, May 1987.

We are developing a computer program (GEOTOX) to model how contaminants move through the air, soil, and water, and how much will be absorbed by people. Eventual goal is to determine which industrial compounds represent the most immediate hazards and therefore merit study more urgently than others. As an illustration, we used GEOTOX to rank the potential exposures to chemicals released during burning or detonation of waste explosives. This ranking exercise also helped us identify gaps in the data base (e.g., soil/plant partitioning and environmental degradation) where improved understanding could make such screening models more useful.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 38623, 38643, 38644, 38661, 38665, 38666, 38982, 39590, 39595, 39596, 39597, 39598, 39599, 39636, 39637, 39646, 39679

39617 **(DPSPU—87-30-1-Vol.1) Savannah River Plant environmental report: Volume 1, Text: Annual report for 1986.** Zeigler, C.C.; Heath, E.M.; Taus, L.B.; Todd, J.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1986. Contract AC09-76SR00001. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012391.

This report contains monitoring data from routine radiological and nonradiological environmental surveillance activities, summaries of environmental protection programs that are in progress, a summary of National Environmental Policy Act (NEPA) activities and a listing of environmental permits and their status issued by regulatory agencies.

39618 **(INIS-BR—641) Behavior of the elements of rare earths group in logging of lateritic alteration in the Lages region (SC, Brazil).** Formoso, M.L.L.; Dani, N.; Valiton, I. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—15-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702476.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39619 **(JAERI-M—86-102) Development of computer code for determining prediction parameters of radionuclide migration in soil layer.** Ogawa, Hiromichi; Ohnuki, Toshihiko. (Japan Atomic Energy Research Inst., Tokyo). Jul 1986. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702512.

A computer code (MIGSTEM-FIT) has been developed to determine the prediction parameters, retardation factor, water flow velocity, and dispersion coefficient of radionuclide migration in soil layer from the concentration distribution of radionuclide in soil layer or in effluent. In this code, the solution of the predicting equation for radionuclide migration is compared with the concentration distribution measured, and the most adequate values of parameter can be determined by the flexible tolerance method. The validity of finite differential method, which was one of the methods to solve the predicting equation, was confirmed by comparison with the analytical solution, and also the validity of fitting method was confirmed by the fitting of the concentration distribution calculated from known parameters. From the examination about the error, it was found that the error of the parameter obtained by using this code was smaller than that of the concentration distribution measured.

39620 (KFK—4170, pp 549-566) **Soil/plant transfer of actinides.** Pimpl, M.; Schmidt, W.; Schuettelkopf, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Hauptabteilung Sicherheit). Aug 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE87780155. (CONF-8606303—).

From Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Jun 1986).

The comparison of the measured and the generally determined transfer factors of Np, Pu, Am and Cm shows that for Pu and Am, the recommended values are realistic, but the transfer behaviour of Cm and Np are overestimated and underestimated by a factor of 10 respectively. Limiting the transfer factor to 3 orders of magnitude realistically reproduces the soil/plant transfer for most soils and plants in the usual growing conditions. A definitive statement on the parameters and mechanisms of root absorption is not possible.

39621 (NIRS-RSD—72, pp 19-20) **Strontium-90 and cesium-137 in soil (from May 1985 to Jul. 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cesium-137 in soil made at eight places across Japan during the period from May to July in 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydroxide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

39622 **(ORNL/TM—10438) A field survey of environmental tritium in areas adjacent to ORNL solid-waste storage areas.** Amano, H.; Garten, C.T. Jr.; Lomax, R.D. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011707.

Environmental Sciences Division Publication No. 2914.

A survey of tritium concentrations in surface water, shallow well water, and atmospheric moisture was made throughout the White Oak Creek Watershed in 1986. Environmental tritium concentrations were elevated south of SWSA-4 and SWSA-5, which seem to be the major contributors of tritium to the watershed. Patterns of tritium in air moisture, surface water, and pine tree cores indicated that there is a major area of tritium migration from SWSA-5 near the middle drainage tributary. Studies at a location south of SWSA-5 showed that tritium concentrations in subsoil water (>10 cm deep) were relatively constant to a depth of 80 cm. Concentrations of tritium in surface soil water (0 to 10 cm) were two to three times less than in the subsoil. Tritium concentrations in air moisture at different heights aboveground were more uniform

during summer than during winter. This difference is attributed to the presence of water vapor transpired by tree foliage and the drying of surface soil during the summer months. Tritium concentrations in tree cores from pines south of SWSA-5 indicated that tritium migration in the vicinity of the middle drainage tributary has perhaps increased during the last 10 years. At this time, it is not known to what extent the tree core data are representative of tritium discharges from SWSA-5 as a whole.

39623 (RFP—4036, pp 16-33) **Dust transport: Windblown and mechanical resuspension.** Langer, G. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

The purpose of the dust transport study is to understand and quantify the physical processes that lead to the resuspension of soil contaminated with plutonium. The soil in question was contaminated 20 years ago with machining oil containing <3-μm plutonium particles. 10 refs., 15 figs., 4 tabs.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 38800, 39646

39624 **(EGG—10282-2154) Sources and rates of mortality of the San Joaquin kit fox, Naval Petroleum Reserve No. 1, Kern County, California, 1980-1986.** Berry, W.H.; Scrivner, J.H.; O'Farrell, T.P.; Harris, C.E.; Kato, T.T.; McCue, P.M. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Mar 1987. Contract AC08-83NV10282. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012332.

Sources and rates of mortality of the San Joaquin kit fox (Vulpes macrotis mutica) were studied from 1980 to 1986. Of 270 foxes radiocollared, 225 were recovered dead. Of the 225 recovered dead 53.8% (121) were killed by predators, 10.7% (24) were killed by vehicles, 4.4% (10) died from causes other than predation, and 31.1% (70) died from unknown causes. Contingency-table analysis was used to assess the relationship between cause of death and sex, age class (juvenile and adult), habitat type (undeveloped and developed), and year of death (1980-1986). More adults in undeveloped habitat were killed by vehicles than were juveniles; more female juveniles in developed habitat were killed by vehicles than female adults; more juveniles were killed by vehicles in developed habitat than in undeveloped habitat; and more adults in developed habitat were killed by predators in later years of the study than in early years. Over 90% of the foxes collared as juveniles were recovered in their first or second year. Fourteen mortality rates based on age class and year of death were estimated using maximum-likelihood estimation. Mortality rates were higher for juvenile foxes (x-bar = 0.74) than for adult foxes (x-bar = 0.52). For foxes collared as juveniles, there was no significant difference in survival between the two habitat types or between the sexes. Mortality of adults increased between 1980 and 1986. Because coyote predation was a major cause of kit fox mortality the coyote control program implemented in 1985 should be continued and its effectiveness should be evaluated by continued monitoring of kit fox, coyote, and prey populations.

39625 **(EPRI-CS—5225) Use of coal ash in highway construction: Georgia demonstration project.** Larrimore, C.L.; Pike, C.W. (Southern Co. Services, Inc., Birmingham, AL (USA); Georgia Power Co., Atlanta (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920475.

EPRI has initiated a program designed to promote ash utilization in roadways, embankments, and backfills - potentially large volume application areas. Included within the EPRI program is a Georgia study involving the development and construction of a demonstration project in which several types of ash were used as major components in highway pavement construction. The primary objective is to plan, design, build and monitor the structural and environmental aspects of a full-scale application of ash in a highway pavement. All planning, design, and construction activities are completed and have been fully described in this report. Both structural and environmental monitorings are in progress and will be reported at the conclusion of study.

5106 Regulations

REFER ALSO TO CITATION(S) 39602, 39603, 39605, 39615

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

39626 **(NP—7770165) Comment on the calculation of the sedimentation of solids in horizontal settling basins.** Schrimpf, W. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen). 1987. 294p. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770165.

The present study deals with horizontal settling basins, which can be divided into non-aerated and aerated structures. The sedimentation of sand-sized particles is considered. A diffusion-convection type equation is applied for the mathematical modelling of the settling behavior in non-aerated grit chambers. For the solution of this partial differential equation a modified explicit difference scheme is used which leads to stable numerical results. The second part of this study discusses the sedimentation of solids in aerated grit chambers.

39627 **(NP—7900890) The ecology of southern California vernal pools: A community profile.** Zedler, P.H. (San Diego State Univ., CA (USA). Dept. of Biology; Fish and Wildlife Service, Slidell, LA (USA). National Wetlands Research Center). May 1987. 150p. Fish & Wildlife Res. Center, 1010 Gause Blvd., Slidell, LA 70458. File Number TI87900890.

Vernal pools are shallow temporary bodies of water that form in winter and spring in the Mediterranean climate region of the Pacific coast. They occur in a diversity of natural settings, often in association with mounded topography. The origin of this mounded topography is still controversial. The short duration of pools and the extreme variation from standing water to severe drought favor a unique fauna and flora. The organisms of vernal pools have special life history features that fit them to this environment. Some of the plants and many of the animals have cosmopolitan distribution, and are found in temporary wetlands at widely scattered locations. Others are extremely restricted in distribution and many are endemic to clusters of pools within the California biotic province. Vernal pools have disappeared at an increasing rate over the past 100 years; because of this, several plant taxa associated with them are listed as rare and endangered by the Federal Government and the State of California.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 38536, 38786, 39022, 39611, 39614, 39616, 39645, 39727, 39733

39628 **(AD-A—179828/9/XAB) Granular activated carbon (GAC) system performance capabilities and optimization. Final report, August 1984-February 1987.** Hinshaw, G.D.; Fanska, C.B.; Fiscus, D.E.; Sorensen, S.A. (Midwest Research Inst., Kansas City, MO (USA)). 27 Feb 1987. 198p. NTIS, PC A09/MF A01.

Performance tests were conducted to determine the capability of granular activated carbon (GAC) to adequately treat pink water (munitions wastewater) from Army ammunition plants (AAPs). Comparative isotherm tests were conducted with five GACs to recommend an optimized grade for pink water treatment and to study temperature and compositional effects. Target effluent criteria of 0.04 mg/L for trinitrotoluene (TNT), 0.03 mg/L for cyclotrimethylenetrinitramine (RDX) or cyclotetramethylenetetranitramine (HMX), and 0.0007 mg/L fo9r 2,4-dinitrotoluene (2,4-DNT) were achieved in the isotherm tests. Pilot-scale multiple

column tests were conducted at Iowa AAP to determine GAC capabilities under typical operating conditions. The effluent criteria were generally met for RDX, HMX, and 2,4-DNT but not for TNT.

39629 **(GKSS—86/E/54) Pervaporation with ion exchange membranes.** Boeddeker, K.W.; Wenzlaff, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 18p. (CONF-8602103—1). NTIS, PC E07; Available from NTIS as TIB/B87-06477.

From 1. international conference on pervaporation processes in the chemical industry; Atlanta, GA, USA (23 Feb 1986).

Sorption and pervaporation of aqueous-organic solvent systems (water-ethanol; water-carboxylic acids) with commercial ion exchange membranes are compared to obtain information on polymersolvent interaction vs. coupling. Close agreement between sorption selectivity and pervaporation selectivity indicates coupling. If pervaporation is less selective than sorption, polymer-solvent interaction overtakes coupling, the limit of de-coupling being phase separation within the sorbate as signaled by a sudden increase in permeability of the lesser interacting component. As long as sorption and pervaporation operate in parallel, favoring enrichment of the same component, coupling enhances the separation effect. If pervaporation counteracts sorption, coupling is detrimental to the separation effect. Potential applications include the dehydration of preconcentrated water-ethanol using anion exchange membranes, and the enrichment of acetic acid from dilute aqueous solution by pervaporative removal of water through cation exchange membranes.

39630 **(ORNL—6320) Instructions for applying the microcomputer version of SWANFLOW-2D on an IBM personal computer.** Bledsoe, J.L.; Fields, D.E. (Oak Ridge National Lab., TN (USA)). [1987]. Contract AC05-84OR21400. 99p. NTIS, PC A05. File Number DE87012004.

SWANFLOW-2D (Simultaneous Water, Air, and Nonaqueous Phase Flow) is a two-dimensional finite-difference code that simulates the flow of water and an immiscible nonaqueous-phase liquid (NAPL) within and below the vadose zone, that region in the earth above permanent groundwater level. The microcomputer version of this FORTRAN-77 code is for an IBM-PC or IBM-AT. User flexibility in building or editing datasets is provided by SWANEDIT, the problem sets are executed using SWANFLOW-2D, and postprocessing of results to yield a graphical interpretation is done with SWANGRAF. This report is intended to provide the new user of the SWANFLOW package of codes (SWANEDIT, SWANFLOW-2D, and SWANGRAF) with documentation that will assist him in this task.

39631 **(PB—87-183208/XAB) Pollution potential of pit quarries employed as waste-disposal sites.** Rechtien, R.D.; Woodbury, C.; Awalt, L.; McDonnell, S. (Missouri Univ., Rolla (USA). Dept. of Geophysics). 22 Nov 1982. 27p. NTIS, PC A03/MF A01.

The use of abandoned pit quarries as waste-disposal sites presents a problem of potential water pollution if leachate is carried through existing channels to areas far removed from the depositional site. A geophysical procedure based upon an electrical resistivity method was used to map small concentrations (volumes) that would represent leakage, or migration, of the leachate from the filled pit. The dipole-dipole electrical resistivity field procedure was found suitable for monitoring leachate from the waste-disposal site known as the Gray Clay mine. An inverse modeling procedure employing alpha centers was adopted to locate small pockets of highly conductive leachate. Although the alpha-center-inversion technique appears to be quite promising as a method of monitoring sanitary landfills for their pollution potential, considerable work is required to refine the method to a practical application method.

39632 **(PB—87-186821/XAB) Polluting incidents in and around US waters: calendar year 1983 and 1984.** (Coast Guard, Washington, DC (USA)). Sep 1986. 84p. (USCG-COMDTINST-M—16450.2G). NTIS, PC A05/MF A01.

The publication provides general information concerning pollution discharges into U.S. navigable waters for CY 1983 and 1984. The data are presented in both tabular and graphic formats. The source of the data is the Pollution Incident tabular and graphic formats. The source of the data is the Pollution Incident Reporting System (PIRS), a computer-based system developed by the Coast Guard to support the Marine Environmental Response Program. PIRS contains data in addition to that published here.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 38623, 38625, 38662, 38665, 38666, 38892, 38911, 39590, 39596, 39597, 39598, 39599, 39646, 39679

39633 **(BMU—1986-104) Assessment of radiological effects of liquid radioactive products from the French Cattenom nuclear power station in the Moselle.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Deutsch-Franzoesische Kommission fuer Fragen der Sicherheit Kerntechnischer Einrichtungen (DFK) (Germany, F.R.)). Sep 1986. 21p. (In German). (DFK—86/1(D)). NTIS, PC E07; Available from NTIS as TIB/B87-06366.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

France has guaranteed a limit of concentration of radioactivity in the Moselle of 20 pCi/l on the daily average, where this concentration is laid down as a limit for the whole Cattenom site and must be strictly complied with. In practice, the value of 4 x 3 Ci/a is not exceeded. On this basis, there is a check of potential radiation exposure of the population in the area below the site, i.e. in Germany and Luxemburg, where the computer model and assumptions of the German authorisation process were used as the basis. The check led to the result that the radiation protection standards of France, Luxembourg and West Germany are complied with, where for the course of the Moselle in Luxembourg and in West Germany, the exposure of the population reaches less than half the legal limit laid down.

39634 **(BMU—1986-110) Potential radiation exposure in German territory due to radioactive products from the Cattenom (F) and Remerschen (L) nuclear power stations in the Moselle.** Buehling. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Fachbereich Kerntechnik). Sep 1986. 43p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06448.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The calculated potential radiation exposure, separately calculated for adults and young children, due to radioactive products from Cattenom and Remerschen to the Moselle is given. For Cattenom, the radiation exposure was calculated for a quantity of 48 Ci of nuclide mixture and 7400 Ci of tritium, based on a nuclide vector given by the applicant and for a quantity of 20 Ci of nuclide mixture and 7400 Ci of tritium. For Remerschen, a quantity of Ci of mixture and 3000 Ci of tritium was used as the basis.

39635 **(BMU—1986-128) Measurements of Ra-226 content of water and drinks in West Germany. Final report.** Glaum, F.; Schastok, J. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Giessen Univ. (Germany, F.R.). Strahlenzentrum). Sep 1986. 31p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06368.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The contamination of the population by Ra 226 in water and drinks can be excluded as a potential source of danger. Average values in pCi/litre: Mineral water - 1.17, spa water - 2.55, beer - 0.57, wine - 0.92, milk - 0.08, tapwater - 0.11, waste water a) incoming - 0.22 b) outgoing - 0.14, activation basin - 1.2. The whole body equivalent doses and annual activity supply for an intake of 440 litres/annum to be expected are: Mineral water - 1.6 x 10/sup -4/ Sv/a, 5.1 x 10/sup -10/ Ci/a, spa water - 3.5 x 10/sup -4/ Sv/a, 1.1 x 10/sup -9/ Ci/a, beer - 7.8 x 10/sup -5/ Sv/a, 2.5 x 10/sup -10/ Ci/a, wine - 1.3 x 10/sup -4/ Sv/a, 4.0 x 10/sup -10/ Ci/a, milk -

1.1 x 10/sup -5/ Sv/a, 3.5 x 10/sup -11/ Ci/a, tapwater - 1.5 x 10/sup -5/ Sv/a, 4.8 x 10/sup -4/ Ci/a.

39636 **(DOE/NV/10384—03) Tatum Dome field study and analysis of monitoring data.** Fordham, J.W.; Fenske, P.R. (Nevada Univ., Reno (USA). Water Resources Center). Dec 1985. Contract AC08-85NV10384. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012367.

This report is a summary and interpretation of data collected at the Tatum Dome Site during April and May 1984. In addition to raw data, description of field activities and laboratory analytical results are presented. The report also includes all analytical results of shallow well samples from the site, and chemical, mineralogical and mechanical analyses of soil samples collected during April 1985. Analysis and interpretation of laboratory analyses are included.

39637 **(DPSPU—87-30-1-Vol.2) Savannah River Plant environmental report: Volume 2, Annual report for 1986.** Zeigler, C.C.; Heath, E.M.; Taus, L.B.; Todd, J.L.; Till, J.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant; Radiological Assessments Corp., Neeses, SC (USA)). 1986. Contract AC09-76SR00001. 329p. NTIS, PC A15. File Number DE87012392.

Figures and tables contain graphic illustrations of sample locations and/or data plus summaries of the following types of data: federal and state standards and guides applicable to operations; concentrations of radioactivity in environmental media; the quantity of radioactivity released to the environment from operations; offsite radiation dose commitments from operations; measurements of physical properties, chemicals and nonradioactive metals concentrations in environmental media; and interlaboratory comparison of analytical results. No attempt has been made to include all data from environmental research programs. Variations in content from year to year reflect changes in the routine environmental monitoring program or the inability to obtain samples from a specific location.

39638 **(FNAL-TM—1462) Unorthodox method of calculating the activation of groundwater by routine SSC [Superconducting Super Collider] operations.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 10p. (CONF-8705134—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010996.

From Workshop on radiological aspects of SSC operation; Berkeley, CA, USA (4 May 1987).

A novel method for estimating the groundwater activation in the environs of the SSC collider ring tunnel is developed. This method, based on the Moyer model, may provide a simpler approach to such estimates and also a check for existing methods. One such method is compared. (LSP)

39639 **(GKSS—87/E/8) /sup 210/Pb and /sup 137/Cs fluxes in a sediment core from Guanabara Bay, Brazil.** Wilken, R.D.; Moreira, I.; Rebello, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.; Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Quimica). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1987. 5p. NTIS, PC E07; Available from NTIS as TIB/B87-08672.

The activities of Pb-210 and Cs-137 were measured in a sediment core collected from the north-west region of Guanabara Bay, Brazil. On the basis of Pb-210 geochronology, a sedimentation rate of 2 cm year/sup -1/ was estimated for the area in recent times. The Cs-137 activity was below the detection limit (0.2-0.8 mBq g/sup -1/) in all depths of the core.

39640 **(INIS-BR—640) Isotopic disequilibrium in 4n chain in auriferous system at Morro do Ferro, Pocos de Caldas (MG) in Brazil.** Bonotto, D.M.; Fujimori, K. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—14-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702475.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39641 (NIRS-RSD—72, pp 15-17) **Strontium-90 and cesium-137 in service water (from December 1984 to July 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cecium-137 in service water made at various places across Japan during the period from Dec. 1984 to July 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydroxide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

39642 (NIRS-RSD—72, pp 18) **Strontium-90 and cesium-137 in freshwater (May, 1985). Environmental and dietary materials.** Mar 1985. NTIS (US Sales Only), PC A02/MF A01. File Number DE87780131.

In Radioactivity survey data in Japan.

This report is aimed at listing measurements of strontium-90 and cesium-137 in freshwater of Kasumigaura-Lake, Ibaragi Prefecture, Japan, made in May of 1985. Collection and pretreatment methods are described for samples of rain and dry fallout, airborne dust, service water and freshwater, soil, sea water, sea sediments, total diet, rice, milk, vegetables, tea, as well as fish, shellfish and seaweeds. The methods for the preparation of these samples for analysis are also outlined. Sample solutions were neutralized with sodium hydroxide, and the precipitate of strontium and calcium carbonates was separated after sodium carbonate was added. The supernatant solution was retained for cesium-137 determination. After being precipitated as oxalates, strontium and calcium were separated by successive fuming nitric acid separations. For the determination of stable strontium, calcium and potassium, soil and sediment were treated with sodium hydroxide and hydrochloric acid for extraction while other samples were ashed and digested. Calcium, separated as oxalate, was determined by titration while stable strontium and potassium were determined by atomic absorption and flame emission spectroscopy, respectively. Couning for activity was carried out using low background beta counters normally for 60 min.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 39646

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 38800, 39018, 39019

39643 **(DOE/BP/14903—1) Protection of wild adult steelhead in Idaho by adipose fin removal: Annual report.** Duke, R. (Idaho Dept. of Fish and Game, Lewiston (USA)). Jun 1987. Contract AI79-84BP14903. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010556.

All Idaho hatchery-reared steelhead released in the spring of 1985 received an adipose fin clip to differentiate between natural or wild and hatchery, fish, thus allowing for protection of wild fish in

the sport harvest. Between 25 September and 14 December 1984, 6,360,542 steelhead trout (Salmo gairdneri) were marked by excising the adipose fin. A total of 10,336 man hours were required to complete the operation. Clip quality and healing, mortality, and adipose fin composition were determined. Quality checks indicated less than 1% of the fish had more than 25% of the fin remaining. Combined mortality at all three hatcheries was 0.3% of the total fish marked. Observed and in vivo test showed complete healing of the excision within 3-4 weeks (observed) and 22 days (in vivo). Bibliographies were compiled for fin regeneration, marked fish survival, hooking mortality, and related catch-and-release studies.

39644 **(LA—11042-MS) A comparison of dissolved and leachable trace metals in Los Alamos drinking water supply and distribution system specimens.** Robinson, R.D.; Knab, D. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012082.

We determined leachable and dissolved priority pollutant trace-metal concentrations in a subset of specimens from the Los Alamos Drinking Water Supply and Distribution System. Leachable lead concentrations obtained, although below the Environmental Protection Agency's Maximium Contaminant Level, averaged 10 ug/L compared with the <1 ug/L for the dissolved species. We also observed differences between leachable and dissolved concentrations for arsenic, barium, chromium and cadmium, but these may be due to a lack of analytical precision. Those observed differences in concentrations between leachable and dissolved metals support an expanded analytical program to include all the specimens collected from the Los Alamos Drinking Water Supply and Distribution System. The expanded program should also include analysis for the secondary pollutant metals copper, iron, manganese, and zinc and a comparison of leachable, total suspended solids and total metals to determine if the differences in concentrations are due to inadequate sample preservation or the presence of nondissolved species.

39645 **(ORNL/TM—10307) National Surface Water Survey: Western Lake Survey: Phase 1, Data base dictionary.** Kanciruk, P.; Gentry, M.; McCord, R.; Hook, L.; Eilers, J.; Best, M.D. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011956.

The Western Lake Survey-Phase I (WLS-I), conducted in the fall of 1985, was the second part of a US Environmental Protection Agency field sampling effort known as the National Surface Water Survey. The WLS-I followed the Eastern Lake Survey-Phase I, which was conducted in the fall of 1984 and included the northeastern, southeastern, and upper midwestern regions of the United States (see "Related Documents"). Both surveys were designed to quantify synoptically the lake chemistry in areas of the United States where the majority of lakes were expected to exhibit low alkalinity. These surveys were conducted as part of the National Acid Precipitation Assessment Program. The survey involved a three-month field effort in which 720 probability sample lakes and 32 special interest lakes in the western regions of the United States were sampled. The Environmental Sciences Division of the Oak Ridge National Laboratory designed and implemented data management and provided data analysis for the WLS-I.

39646 **(SRO—819-17) Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.** McCort, W.D.; Wolf, R.B. (eds.). (Savannah River Ecology Lab., Aiken, SC (USA)). Sep 1986. Contract AC09-76SR00819. 185p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87012054.

This report presents descriptions of research projects conducted during the past year. The projects are grouped into three areas: biogeochemical ecology; wetlands ecology, and stress and wildlife ecology. Separate abstracts have been prepared for the three research areas. (ACR)

39647 **(TVA/ONRED/WRF—85/1a) Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984.** Bruggink, D.J.; Buchanan, J.P.; Dycus, D.L.; Murray, S.A.; Ostrowski, P. Jr.; Smith, A.O.; Swor, C.T.; Tomljanovich, D.A.; Wade, D.C.; Webb, D.H. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jun 1985. 409p. NTIS, PC A18/MF A01. File Number DE87900881.

The Tennessee Valley Authority has conducted water quality and biological monitoring in Chickamauga Reservoir from 1980 through 1984 as required by the National Pollutant Discharge Elimination System Permit for Sequoyah Nuclear Plant (SQN). Evaluation of 1984 operational monitoring data, comparison of these data to previous operational and preoperational data, and recommendations for continuation or discontinuation of each type of study are presented in this report. Plant operations, which were limited during the initial period of operational monitoring (1980 and 1981) because of plant testing, increased in 1982 and probably reflected "normal" conditions in 1983 and 1984. Comparisons of aquatic parameters upstream and downstream of SQN showed numerous differences among stations and/or over time. Most of these differences were considered unimportant or thought to be associated with factors other than SQN. Therefore, it is recommended that the following be discontinued: benthic macroinvertebrate community studies; mollusk bioaccumulation studies; fish impingement studies; fish gill net studies; and fish creel studies. Plankton studies should continue.

5206 Regulations

REFER ALSO TO CITATION(S) 39602, 39603, 39605

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 39009

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 38619, 39561, 39602, 39617, 39647

39648 **(AERE-R—12057-Vol.A) Studies on the risk of electricity generation: a comparative assessment. Class A: coal.** Rose, K.S.B.; Billington, D.E. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Feb 1987. 112p. H.M. Stationery Office, London, price Pound 7.00.

This report is the first of a series that addresses the mortality risk associated with the various power technologies. The best available estimate of the British mortality risk, measured in terms of the numbers of deaths per GW-year of electricity for coal is either 1.9 deaths or 11.8 deaths per GW-year of electricity. The technology is considered in terms of 20 risk elements and risk values are assigned to each element, where this is possible. For the lower value of 1.9 deaths per GW-year of electricity, coal mining (harvesting) comprises 78 per cent of the total risk, mainly from accidental deaths in mines rather than from fatal disease among the miners. For the higher value of 11.8 deaths per GW-year of electricity, 85 per cent of the total risk arises from fatal disease among members of the public exposed to gaseous effluents from power stations. The possibility of major accidents is identified, associated with five risk elements, notably in the transport and storage of chlorine. However, frequency-consequence lines have not been calculated for any of these types of accidents.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 38701, 39316

39649 **(DOE/ER/60163—3) Papovavirus probes for DNA repair in human cells: Final report, August 15, 1983-May 15, 1987.** Krisch, R.E. (Pennsylvania Univ., Philadelphia (USA). Dept. of Radiation Therapy). Jun 1987. Contract AC02-83ER60163. 21p. NTIS, PC A02. File Number DE87012461.

Extracellularly gamma irradiated simian virus 40 (SV40) was used as a model system to study the induction and intracellular repair of DSB (double-strand DNA breaks) and SSB (single-strand DNA breaks) in higher cells. The optimal experimental conditions for this approach were determined and the comparability of radiation dose-response data were compared with those obtained by other techniques. Experiments in progress suggest that limited accessibility of heavily irradiated viral DNA to host cell enzymes leads to variable rates of repair of DSB or SSB. The effects of DNA configuration and molecular environment on the radiation induction of DSB, using SV40 as a model system are addressed. Results indicate that the intranuclear environment is highly protective against DSB induced by ionizing radiation. 9 refs., 11 figs., 3 tabs.

39650 **(LA—11029-MS) New apparatus for direct counting of β particles from two-dimensional gels and an application to changes in protein synthesis due to cell density.** Anderson, H.L.; Puck, T.T.; Shera, E.B. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012695.

A new method is described for scanning two-dimensional gels by the direct counting of β particles instead of autoradiography. The methodology is described; results are compared with autoradiographic results; and data are presented demonstrating changed patterns of protein synthesis accompanying changes in cell density. The method is rapid and permits identification of differences in protein abundance of approximately 10% for a substantial fraction of the more prominent proteins. A modulation effect of more than 5 standard deviations, accompanying contact inhibition of cell growth, is shown to occur for an appreciable number of these proteins. The method promises to be applicable to a variety of biochemical and genetic experiments designed to delineate changes in protein synthesis accompanying changes in genome, molecular environment, history, and state of differentiation of the cell populations studied. 13 refs., 8 figs., 4 tabs.

5504 Genetics

REFER ALSO TO CITATION(S) 39689, 40283

5505 Metabolism

REFER ALSO TO CITATION(S) 38701, 39696

39651 **(INIS-mf—10692) Autoradiographic research on cell proliferation of prenatal rat lung cells and their influence using the mitogen Kallikrein.** Bock-Lamberlin, P.R. (Hamburg Univ. (Germany, F.R.). Fachbereich 4 Medizin). 27 Nov 1980. 100p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10189.

In this work autoradiographic experiments were carried out on the kinetics of proliferation of four cell populations of the prenatal rat lung with the help of the determination of the /sup 3/H-thymidine marker indices, with the following results: 1. The four studied cell populations exhibited variable proliferation rates on the twentieth or twenty-first day of development. 2. The strongest affect of the exogenously applied mitogen Kallikrein was demonstrated on the vessel wall cells, the next strongest on the bronchial epithelial cells, then the cartilage cells and finally the alveolar wall cells. 3. The mitogenic effect is dependent on dose. Higher doses significantly increased the /sup 3/H-thymidine marker indices of the four cell populations tested in this work. 4. When the exposure time of the Kallikrein was extended by one hour this lead partially to stronger mitogenic effects than by the shorter exposure times at the same and higher dose levels of mitogen. 5. The /sup 3/H-thymidine marker indices are dependent on the exposure time. 6. With increasing litter size, the /sup 3/H indices as a rule decrease.

5506 Medicine

REFER ALSO TO CITATION(S) 39338, 39339, 39339

39652 **(BNL—39792) The synchrotron radiation angiography program at the national synchrotron light source.** Thomlinson, W.; Gmuer, N. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-8705123—1). NTIS, PC A02. File Number DE87010761.

From International meeting on synchrotron radiation applications to digital subtraction angiography; Frascati, Italy (6 May 1987).

The National Synchrotron Light Source (NSLS) angiography program is under development. The program is a collaboration between the Stanford University Angiography Project and the NSLS. A 180 m^2 clinical facility has been built. A beam line is being constructed to utilize a superconducting wiggler radiation source. Projected start-up date for the NSLS program is Summer 1988.

39653 **(INIS-BR—651) Proceedings of the 7. Brazilian Meeting on Nuclear Medicine.** (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1985. 21p. (In Portuguese). (CONF-8511286—). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483.

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

Subjects about nuclear medicine are discussed. Researchs concerning the use of radioisotopes as tracers in several diseases are presented. The use of radioisotopes in diagnosis are emphasized. (M.A.C.).

39654 (INIS-BR—651, pp 2) **Evaluation of tumor labellers (apha-pheto and B-HCG) dosage in attendance of carriers of testicle carcinoma.** Corbo, R.; Fonseca, L.M.B.; Correa, H.H.; Balestrero, R.R. (Instituto Nacional do Cancer, Rio de Janeiro, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39655 (INIS-BR—651, pp 4) **Scintiscanning with /sup 99m/Tc - glucoheptonate in pulmonary interculosis.** Rizzo, J.A.; Souza, M.A.C.L.A.; Almeida, C.A.; Azevedo, R.A.; Wanderley, G.; Souza, H.M. (Pernambuco Univ., Recife, Brazil; Pernambuco Univ., Recife, Brazil. Faculdade de Medicina). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39656 (INIS-BR—651, pp 5) **Comparative study of scintigraphy, radiography and bronchoscopy in bronchial carcinoma.** Lins, J.A.; Jansen, J.M.; Plotkowski, L.M. (Centro de Fisiopatologia Pulmonar, Rio de Janeiro, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39657 (INIS-BR—651, pp 6) **Curves of regional myocardic activity in carrier patients of coronary artery disease under myocardic mapping with thallium 201 associated with effort test.** Hironaka, F.H.; Meneguetti, J.C.; Giorgi, M.C.P.; Dias Neto, A.L.; Godoy, M.; Camargo, E.E. (Sao Paulo Univ., Brazil. Faculdade de Medicina). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39658 (INIS-BR—651, pp 7) **Compartive studies of isosorbitol propatil dinitrate, nitrate and placebo effects in effort test associated with myocardial scintiscanning with thallium 201 in chronic coronary insufficiency.** Marques, J.M.; Savioli, F.; Sousa, J.E.M.R.; Thom, A.F.; Martins, L.R.F.; Batlouni, M.A.D.; Kuvabara, M. (Instituto Dante Pazzanese de Cardiologia, Sao Paulo, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39659 (INIS-BR—651, pp 8) **Renal dymanic study (DTPA /sup 99m/Tc) in early evaluation of renal transplant.** Soares Junior, J.; Meneguetti, J.C.; Mulinari, M.P.; Noronha, I.L.; Barcelos, M.A.F.; Camargo, E.E. (Sao Paulo Univ., Brazil. Faculdade de Medicina). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39660 (INIS-BR—651, pp 10) **Air experience with HGH stimulus test by clonidine.** Gomes, M.A.B.; Laun, I.C.; Oliveira, I.M.; Cardoso, V.M.; Jorge, R.C.F.; Rolim, S.; Lopes, M.M.B.; Morinigo, F.; Lobo, G.B. (Hospital dos Servidores do Estado, Rio de Janeiro, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39661 (INIS-BR—651, pp 11) **Dosage of beta HCG on hydateform mole control.** Gomes, M.A.B.; Oliveira, I.M.; Cardoso, V.M.; Jorge, R.C.F.; Lima, S.R.G.; Rolim, S.; Lobo, G.B. (Hospital dos Servidores do Estado, Rio de Janeiro, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39662 (INIS-BR—651, pp 16) **Esophageal transit with radionuclide - A test for esophageal function.** Fonseca, L.M.B.; Leme, E.; Penas, M.E.; Maliska, C.; Martinho, M.J.R. (Rio de Janeiro Univ., Brazil. Hospital Universitario). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39663 (INIS-BR—651, pp 18) **Our experience in bone scintigraphy in patients of neuroblastome.** Silva, E.M.P.S.A.; Giorgi, M.C.P.; Torres, J.B.; Odone Filho, V.; Maluff Junior, P.T.; Camargo, E.E. (Instituto da Crianca, Sao Paulo, Brazil. Centro de Medicina Nuclear). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39664 (INIS-BR—651, pp 20) **Treatment of thyroid differentiate carcinoma with radioactive iodine - 4 years of attendance.** Fonseca, L.M.B.; Gorbo, R.; Antonucci, J.B.; Pedras, D.S.V. (Instituto Nacional do Cancer, Rio de Janeiro, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39665 (INIS-mf—10892) **Thermoluminescent dosimetry applied to radiotherapy carried out around the Therac-20-Saturne linear accelerator.** Bennab, K. (Commissariat aux Energies Nouvelles, Algiers (Algeria). Centre de Developpement des Techniques de Base). Oct 1984. 133p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702484.

In the first part of this work, the physical and technical aspects necessary to a radiotherapy treatment planning elaboration are presented. These include the apparatus description as well as the measurements of the dosimetric quantities relative to the delivered beams. Since in-vivo measurements are very useful to optimise the treatment conditions, the second part deals with thermoluminescent dosimeters, their characteristics and their setting out such as they be used with maximum efficiency. In-vivo measurements carried out enabled us to estimate the delivered dose to a given tumor with a precision down to +-4%. The registered differences between the measured dose and the prescribed one made possible an appropriate corrective action. Because of the difficulties encountered with conventional dosimetric systems when used in narrow beam measurements, the authors have developed a new method making use of TL dosimeters. The results obtained will allow treatments of small volume tumors with the significant advantage of saving healthy surrounding tissues from irradiation.

39666 **Radioimmunodetection of human tumor xenografts by monoclonal antibody F(ab')$_2$ fragments.** Herlyn, D.; Munz, D.L.; Herlyn, M.; Koprowski, H.; Powe, J.; Alavi, A.; Meinken, G.E.; Srivastava, S.C. (Wistar Inst. of Anatomy and Biology, Philadelphia, PA, USA; Victoria Hospital, London, Ontario, CA; Pennsylvania Univ., Philadelphia, US. Hospital; Brookhaven National Lab., Upton, NY, USA). *Nuclear Medicine and Biology;* **13**: No. 4, 401-405(1986). (CONF-8504307—).

From Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides; Miami Beach, FL, USA (29 Apr 1985).

Procedures are described for the radiolocalization of human tumors by murine monoclonal antibodies (MAb) in animal model systems. Visualization of tumor xenografts was clearer in nude mice compared to experimentally immunosuppressed mice due to the higher tumor viability. MAb localization in tumor tissue was greatly enhanced when F(ab')$_2$ fragments rather than intact antibody molecules were used. Although tumors could be visualized with ^{131}I-, ^{123}I-or ^{111}In-labeled MAb fragments without background subtraction, tumor-to-background ratios of radioactivity were highest for ^{131}I-labeled fragments. ^{131}I-labeled F(ab')$_2$ fragments of eight MAb against human colorectal carcinoma, melanoma or lung carcinoma localized specifically only in those tumors that bound the MAb in vitro and not in unrelated tumors. Radiolabeled fragments of MAb with other specificities (anti-hepatitis virus MAb) did not localize in tumors. All MAb that inhibited tumor growth in nude mice effectively localized these tumors by γ-scintigraphy. Some MAb were effective in localizing tumors but ineffective in inhibiting their growth. The ability of the specific radiolabeled F(ab')$_2$ fragments to localize in tumor grafts correlated significantly with MAb binding affinity and density of antigenic sites on tumor cells together, but not with either in vitro binding parameter alone.

39667 **Potential application of labeled antibodies for thrombus detection.** Ezekowitz, M.D.; Coller, B.S.; Srivastava, S.C. (Yale Univ., New Haven, CT, USA. School of Medicine; State Univ. of New York, Stony Brook, USA; Brookhaven National Lab., Upton, NY, USA). *Nuclear Medicine and Biology;* **13**: No. 4, 407-411(1986). (CONF-8504307—).

From Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides; Miami Beach, FL, USA (29 Apr 1985).

Labeling platelets with monoclonal antibodies in whole blood for imaging thrombi is less cumbersome than the established ^{111}In-oxine method. 7E3, a murine monoclonal antibody directed against glycoprotein IIb and/or IIIa on both human and dog platelets was used to label canine platelets. Thrombi were induced by transcatheter placement of a copper coil followed by electrocoagulation. 7E3 was iodinated with ^{131}I and labelled with ^{111}In using 7E3-DTPA conjugate. Whole blood was incubated with 0.5 - 1.0 μg labeled 7E3/mL blood. In 4/4 dogs, experimental deep vein thrombi were identified using both ^{131}I-and ^{111}In-labeled 7E3 within 5-30 min after injection. For both isotopes, 1 h blood clearance was 54 + - 9%. In 1/3 dogs, experimental coronary thrombus could be identified ex vivo at 4 h. Clot to blood ratios ranged between 7 to 13:1. Using the ^{111}In-oxine method, 0/3 coronary thrombi were seen. Thus, ^{131}I-and ^{111}In-labeled 7E3 may be used to readily identify peripheral venous thrombi. For reliable and prompt identification of coronary thrombi, more rapid clearance of the labeled platelets is required.

39668 **Use of radionuclides for tumor therapy.** Fawwaz, R.A.; Wang, T.S.T.; Hardy, M.A.; Srivastava, S.C. (Columbia Univ., New York, USA. Coll. of Physicians and Surgeons; Brookhaven National Lab., Upton, NY, USA). *Nuclear Medicine and Biology;* **13**: No. 4, 429-436(1986). (CONF-8504307—).

From Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides; Miami Beach, FL, USA (29 Apr 1985).

The successful use of radionuclides for tumor therapy depends to a major extent on the ability to achieve a high concentration of radioactivity in the tumor relative to other radiosensitive organs not involved by tumor, such as bone marrow, intestinal mucosa, liver, and kidneys. Techniques designed to achieve such differential localization of the radionuclides include the use of (1) radiopharmaceuticals that enter specific metabolic pathways unique to certain tumor types; (2) radiolabeled antibodies that attach to tumor-associated antigens present on tumor cell surfaces; (3) heterologous antibodies that attach to tumor-associated antigens present on tumor cell surfaces and which are then identified by radiolabeled antibodies directed against the species in which the original, unlabeled antibody was made; and (4) radiolabeled compounds injected regionally at the tumor site. Although both clinical and experimental evidence on the use of radionuclides for tumor therapy is encouraging in preliminary studies, extensive further research needs to be done in this area to insure the clinical efficacy of radionuclides for tumor therapy.

39669 **^{90}Y-labeled monoclonal antibodies for cancer therapy.** Washburn, L.C.; Hwa Sun, T.T.; Crook, J.E.; Byrd, B.L.; Carlton, J.E.; Hung, Y.-W.; Steplewski, Z.S. (Oak Ridge Associated Universities, Inc., TN, USA. Medical and Health Science Div.; Wistar Inst. of Anatomy and Biology, Philadelphia, PA, USA). *Nuclear Medicine and Biology;* **13**: No. 4, 453-456(1986). (CONF-8504307—).

From Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides; Miami Beach, FL, USA (29 Apr 1985).

Monoclonal antibody 17-1A, which has specificity for colorectal carcinoma, was labeled with ^{90}Y (10-20% radiolabeling yield). Tissue distribution studies in tumor-bearing nude mice were carried out. ^{90}Y-labeled 17-1A showed good uptake in the SW 948 colon carcinoma cell line. However, ^{90}Y-labeled A5C3, a monoclonal antihepatitis virus antibody studied as a control, showed similar uptake in this tumor. Neither antibody was taken up well by a WM-9 melanoma. It is believed that the loss of specificity observed is due to the low specific activity of the ^{90}Y-labeled monoclonal antibody preparations used. This hypothesis is supported by radioimmunoassay data.

5507 Microbiology

REFER ALSO TO CITATION(S) 38699, 39649

5509 Pathology

REFER ALSO TO CITATION(S) 38721

5510 Physiological Systems

39670 **(CONF-8705160—2) Belowground-system development of VA mycorrhiza in a restored tallgrass prairie community.** Cook, B.D.; Jastrow, J.D.; Miller, R.M.; McGraw, A.C. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 2p. NTIS, PC A02. File Number DE87012218.

From 7. North American conference on mycorrhizae; Gainesville, FL, USA (3 May 1987).

This study was conducted to determine the relationship between root and VA mycorrhizal fungus development in a tallgrass prairie restoration chronosequence. Emphasis is placed on characterizing the relationship of root length, colonized root length, and percentage of root length occupied by the mycorrhizal fungus by differing root size classes. Mycorrhizal fungus composition and populations along the restoration chronosequence was determined. 3 refs., 1 fig.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 39295

39671 **(DOE/SR/10702—6) Improving tree growth on poor and medium sites through the use of legumes: Final report for the period September 1, 1980 to December 31, 1985.** Jorgensen, J.R. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). Dec 1985. Contract AI09-80SR10702. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012146.

Sericea (Lespedeza cuneata L.) can be used to increase the productivity of many forest soils through nitrogen fixation and improvements in cycling of other nutrients. Sericea can be established with minimal site preparation, such as burning, and by sowing 10 pounds of seed per acre. Phosphorus is required on many sites for the maintenance of the sericea stand, but has no influence on the stand's initial establishment. Nitrogen fixation ranges up to 100 lbs/acre annually, and is related to biomass of the nitrogen-fixing plants. Foliar analyses of loblolly and sand pine indicate that the nitrogen fixed is available, but that tree growth response may not occur until three or four years after sericea establishment. Significant growth increases of 10 to 15% have been measured following the initial lag. Growth responses may not occur where other factors, such as a lack of moisture on deep sands, control tree growth more than does the lack of available nutrients. Dense stands of sericea may reduce survival of planted pine seedlings during their first year in the field. Survival of older trees is not affected by sericea competition.

39672 **(INIS-BR—651, pp 12) Removal and reutillization of organic material from young enamel by secretory ameloblasts visualized by radioautography.** Castro, Z.S.; Blumen, G.; Merzel, J. (Universidade Estadual de Campinas, Piracicaba, Brazil. Faculdade de Odontologia). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39673 **(RISO-M—2626) Agricultural Research Department annual report 1986.** (Risoe National Lab., Roskilde (Denmark)). Jan 1987. 56p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751931.

The annual report begins with a general review of the research work of the department. The activities of the year are described in 5 short project reports and in the lists of publications and of lectures and seminars. Further, the report includes 4 review articles on selected subjects related to the work on the department, and a list of the staff and students of the year.

39674 **(TVA/OACD—87/15) 1986 Fertilizer Summary Data.** Berry, J.T.; Hargett, N.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). May 1987. 134p. NTIS, PC A07. File Number DE87900885.

"Fertilizer Summary Data" is published every two years as part of TVA's fertilizer research, development, and education program. It brings together historical fertilizer use and crop statistics, application rates, and farm income and expense data for market planning and evaluation. This edition summarizes US consumption (including Puerto Rico) of fertilizer and plant nutrients through the year ended June 30, 1986.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 39649

39675 **(AD-A—179771/1/XAB) AFRRI (Armed Forces Radiobiology Research Institute) reports, October, November, December 1986. Technical report.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 215p. NTIS, PC A10/MF A01.

Includes rept. nos. AFRRI-SR86—34 through AFRRI-SR86—52 and AFRRI-TR86—3.

Contents include: neutron-induced free radicals in oriented DNA; evidence of de novo membrane generation in the mechanism of mast-cell secretary granule activation; dose dependent radiation-induced hypotension in the canine; formulation of cytosine glycol and 5,6-dihydroxycytosine in deoxyribonucleic acid on treatment with osmium tetroxide; hepotabiliary kinetics after whole-body irradiation; the role of endogenous prostaglandins in the regulation of gastric secretion in rhesus monkeys; circadian rhythms in catecholamine metabolites and cyclic nucleotide production; relationships between behavioral rhythms, plasma corticosterone and hypothalamic circadian rhythms; a novel interaction of diethyldithiocarbamate with the glutathione/glutathione peroxidase system; inhibition of glutathione peroxidase and glutathione transferase in mouse liver by misonidazole; organophosphate-induced histamine release from mast cells; hemopoietic effects of intravenous soluble glucan administration; single-electrode voltage clamp in mammalian electrophysiology; prostaglandin-mediated suppression of delayed-type hypersensitivity to infected erthyrocytes during babesia microti infection in mice; gastric protection by sucralfate; urinary excretion of cyclic nucleotides, creatinine prostaglandin E2 and thromboxane B2 from mice exposed to whole-body irradiation from an enhanced neutron field; performance characteristics of a high-level solid-state personnel dosimetry system in pulsed radiation environments; development of a model system to study leukotriene-induced modification of radiation sensitivity in mammalian cells.

39676 **(BARC—1312) Organ burdens and elimination rates of inhaled thorium and plutonium.** Unnikrishnan, K.; Murthy, K.B.S.; Sunta, C.M. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702423.

For the purpose of interpreting observations from internal monitoring programmes, organ burdens and excretion rates resulting from inhalation of long-lived isotopes of plutonium and thorium have been calculated, on the basis of the ICRP model. Two types of inhalation, instantaneous (acute) and at a steady rate (chronic) are considered. The expected buildups of the burden in lungs, lymph nodes, bone, liver and other tissues, as well as the excretion rates, have been calculated for aerosol classes W and Y, and particle sizes of AMAD 1 μm and 6 μm. Further, in view of their use in selecting the periodicity of routine monitoring, theoretical results are also presented for the case of a total inhalation of 1 ALI in one year, instantaneously or at a constant rate. 41 figures, 13 tables.

39677 **(EUR—9728) Council directive of 3 September 1984 laying down basic measures for the radiation protection of persons undergoing medical examination or treatment. Council directive of 3 September 1984 amending Directive 80/836/EURATOM as regards the basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation.** (Commission of the European Communities, Luxembourg). 1985. 165p. (In French). Commission of the European Communities, Luxembourg.

On 2 February 1959, the Council adopted directives establishing basic safety standards for the health of the general public and workers against the dangers arising from ionizing radiations. These directives were modified partially by the Directives of 5 March 1962, 27 October 1966, 1 June 1976 and 15 July 1980. The present edition reproduces the complete text of the Directive amending Directive 80/836/Euratom as regards the basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation, adopted by the Council on 3 September 1984. The first Directive laying down basic measures for the radiation protection of persons undergoing medical examination or treatment, adopted by the Council on 3 September 1984 is also given in this report.

39678 **(EUR—10289) Methods for assessment of the consequences of irradiation of populations.** (Commission of the European Communities, Luxembourg). 1986. 194p. (In French and English). Commission of the European Communities, Luxembourg.

The Contract of Association, concluded in 1981 between the European Community of Atomic Energy on one hand and the French Commissariat a l'Energie Atomique on the other, is aimed at developing methods for assessing the consequences of population irradiation. This is the continuation of the preceding contract concluded in 1976 on the search for methods suited to put into practice the recommendations of the International Commission for Radiological Protection and the European directives, especially concerning the justification of exposure as well as the optimization of protection. The research program consists of two projects. Methods for assessing individual and collective doses resulting from different types of exposure to ionizing radiations. Methods for assessing the radiological detriment and its cost.

39679 **(EUR—10452) Progress Report - Programme - Radiation protection - 1985.** (Commission of the European Communities, Luxembourg). 1986. 1418p. (In French, English and German). Commission of the European Communities, Luxembourg.

The progress report of the radiation protection programme outlines the research work carried out in the year 1985 under contracts between the Commission of the European Communities and research groups in the Member States. Results of more than 300 projects are reported. They are grouped into six sectors: radiation dosimetry and its interpretation, behaviour and control of radionuclides in the environment, non-stochastic effects of ionizing radiation, radiation carcinogenesis, genetic effects of ionizing radiation, evaluation of radiation risks and optimization of protection. Within the framework programme, the aim of this scientific research is to improve the conditions of life with respect to work and protection of man and his environment and to assure a safe production of energy, i.e. (i) to improve methods necessary to protect workers and the population by updating the scientific basis for appropriate standards, (ii) to prevent and counteract harmful effects of radiation, (iii) to assess radiation risks and provide methods to cope with the consequences of radiation accidents.

39680 **(GSF—5/86) Investigation of the radiation dose to trees due to natural and artificial radiation sources.** Jacobi, W.; Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Mar 1986. 60p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-08448.

The results of the study show that the current radiation exposure of trees or parts of trees (e.g. leaves, needles, roots) practically exclusively is due to the ionizing radiation of natural sources. The dose contributed by radioactive, airborne emissions from nuclear power stations is relatively small, even in the vicinity of the stations. Uptake of radioactive noble gases by plants administers only a very small dose to leaves or needles. The dose rate received by green leaf or needle trees is not very different. However, due to the different lifetime of the trees, the cumulative dose to needle trees is expected to be higher by a factor of 10 on the average. In areas of normal natural soil or airborne activity, an average cumulative energy dose of 1 or 10 mGy, to leaves or needles respectively, as a result of natural radiation is expected.

39681 (INIS-BR—651, pp 19) **99m Tc-MDP deposition in testicle.** Calegaro, J.U.M.; Carvalho, A.C.M. (Hospital de Base do Distrito Federal, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

39682 **(ISH—90) Biological indicators of radiation exposure. Experimental study of radiation-induced changes of thymidine level in human serum.** Stamm, A.; Stumpf, E.; Boegl, W.; Willich, N. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1986. 86p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-06307.

The study summarizes the results of the search for a reliable quantitative biochemical indicator system for ionizing radiation in man. Thymidine seems to be a promising indicator in the serum. The analysis of thymidine is based on the inhibited incorporation of /sup 125/I-UdR into DNA of fibroblast cells in the presence of serum of the irradiated mice. Maximal inhibition of the I-UdR-incorporation occurs 4 hours after irradiation. The data from animal experiments show in the dose range between 0.005 and 1 Gy a dose effect relationship which was multiply reproduced. The main objective of the experiments is to test the transferability of results from mouse to man. What little is known on these effects in humans was learned from investigations in radiotherapy patients. Up to now, 22 radiotherapy patients have been examined and in no case dose dependency for the increase of thymidine concentration in human serum as a function of radiation dose has been observed. Among the tumour patients investigated, three groups were found to be of special interest: one group with a low initial thymidine concentration increasing after irradiation, a second group of patients with a high initial thymidine concentration decreasing after irradiation and a third group with a middle initial thymidine concentration not changing after irradiation. A dependency of the effect from time, as it occurs in the mouse, has not been observed in man until now. Thus the applicability of this biochemical indicator system as evidence of a radiation exposure in man has not been proven.

39683 **(KFK—4172) Studies on the biological behaviour of uranium-plutonium mixed oxide aerosols: Inhalation experiments with rats and in vitro studies with alveolar macrophages.** Mueller, H.L.; Drosselmeyer, E.; Hotz, G.; Seidel, A.; Thiele, H.; Pickering, S.; Ray, I.C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Feb 1987. 212p. (In German). (EUR—10846-DE). NTIS, PC E15; Available from NTIS as TIB/B87-06454.

The retention of spherical and of irregularly shaped (U, Pu) mixed oxides in rat lung was analyzed after inhalation and intratracheal instillation. Their biological behaviour was relatively independent of particle shape and application route with only a few percent of radioactivity being transferred to other organs. In vivo and in vitro uptake and intracellular distribution in rat and bovine alveolar macrophages were analyzed as dependent on various parameters. In addition, detailed electron microscopic studies were performed demonstrating particles within membrane limited vacuoles as well as lying free in the cytoplasm. Under in vitro conditions the uptake process was finished after a few hours. After differential centrifugation of lung or macrophage homogenates the particles sedimented in the first (1000 g) fraction.

39684 **(LA-UR—87-1955) External exposure estimates for individuals near the Nevada Test Site.** Henderson, R.W.; Smale, R.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 23p. (CONF-870771—1). NTIS, PC A02/MFA01; 1; GPO Dep. File Number DE87011782.

From Evaluation of environmental radiation exposures from nuclear testing in Nevada; Salt Lake City, UT, USA (9 Jul 1987).

Individuals living near the Nevada Test Site were exposed to both beta and gamma radiations from fission products and activation products resulting from the atmospheric testing of nuclear devices. These exposures were functions of the amount of material deposited, the time of arrival of the debris, and the amount of shielding afforded by structures. Results are presented for each of nine generic life styles. These are representative of the living patterns of the people residing in the area. For each event at each location for which data exist, a representative of each life style was closely followed for a period of thirty days. The results of these detailed calculations are then extrapolated to the present. 7 refs., 5 figs., 2 tabs.

39685 **(NIRS-AR—28) Annual report of National Institute of Radiological Sciences of the fiscal year 1984.** (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1985. 209p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87702536.

The activities of National Institute of Radiological sciences in fiscal year 1984 were carried out on the basis of the total budget of 6052 million yen and 408 regular staffs. The ordinary research is the base of all research activities, and was carried out on 62 subjects, which achieved the results of internationally high level. The special research was performed by selecting four themes, that is, the investigation and research on the biological effect of tritium accompanying the development of nuclear fusion, the investigation and research on the probabilistic effect of radiation and risk evaluation, the investigation and research on the evaluation of environmental radiation exposure, and the investigation and research on the medical utilization of heavy particle beam and others. In addition, the specified research and the research using the science and technology promotion coordination expense were carried out. The total number of trainees who have finished various courses of the Education and Training Division reached 3466 in fiscal year 1984, and those contributed largely to the protection and utilization of radiation in Japan. Effort was exerted to promote the international exchange in this field. The activities in respective divisions are reported.

39686 **(PNL-SA—14684) The Hanford study: Issues in analyzing and interpreting data from occupational studies.** Gilbert, E.S. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 6p. (CONF-870534—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011990.

From Conference on health effects of low dose ionizing radiation: recent advances and their applications; London, UK (11 May 1987).

Updated analyses of workers at the Hanford site provided no evidence of a correlation of radiation exposure and mortality from all cancers or mortality from leukemia. Potentially confounding factors were examined, and to the extent possible taken account of in these analyses. Risk estimates for leukemia and for all cancers except leukemia were calculated and compared with those from other sources. For leukemia, consideration was given to modifying factors such as age at exposure and time from exposure. 19 refs., 4 tabs.

39687 (RERF-TR—4-83) Chromosome aberration analysis based on a beta-binomial distribution. Otake, M.; Prentice, R.L. (Radiation Effects Research Foundation, Hiroshima (Japan)). Oct 1983. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702549.

Analyses carried out here generalized on earlier studies of chromosomal aberrations in the populations of Hiroshima and Nagasaki, by allowing extra-binomial variation in aberrant cell counts corresponding to within-subject correlations in cell aberrations. Strong within-subject correlations were detected with corresponding standard errors for the average number of aberrant cells that were often substantially larger than was previously assumed. The extra-binomial variation is accomodated in the analysis in the present report, as described in the section on dose-response models, by using a beta-binomial (B-B) variance structure. It is emphasized that we have generally satisfactory agreement between the observed and the B-B fitted frequencies by city-dose category. The chromosomal aberration data considered here are not extensive enough to allow a precise discrimination between competing dose-response models. A quadratic gamma ray and linear neutron model, however, most closely fits the chromosome data.

39688 (RERF-TR—13-83) Serum autoantibodies in atomic bomb survivors, Hiroshima and Nagasaki. Akiyama, M.; Yamakido, M.; Hamilton, H.B.; Kobuke, K.; Fujiwara, S.; Hakoda, M.; Kyoizumi, S.; Yoshimoto, K.; Fujikura, T. (Radiation Effects Research Foundation, Hiroshima (Japan)). Dec 1983. 10p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702550.

In order to evaluate delayed effects of radiation on humoral immunity, an attempt was made to detect antibodies in the serum of atomic bomb survivors against kidney, liver, and parietal cells from rats. The following results were observed. Comparing by sex and age, the detection frequency of antibodies increased significantly for all three organs in the male group only. Analysis of changes in antibody detection frequencies by age and exposure dose without considering sex showed that the rates for those exposed to 100 + rad showed a trend to increase with age for all three organs. However, in the 0 rad group, a significant trend to increase with age was noted for antikidney and antiliver antibodies only. Analysis of changes in antibody detection frequencies by sex, age, and exposure dose showed that the detection frequencies increased significantly with age for all three organs in males exposed to 100 + rad, but only the antiliver antibody frequency increased significantly with age in males in the 0 rad exposure group. Females failed to show any statistical changes in any exposure group.

39689 (RERF-TR—22-85) Proliferation, differentiation, and possible radiation-induced chromosome abnormalities in circulating hemopoietic stem cells. Amenomori, T.; Honda, T.; Matsuo, T.; Otake, M.; Hazama, R.; Tomonaga, Y.; Tomonaga, M.; Ichimaru, M. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jul 1986. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702551.

The effects of atomic bomb radiation on hemopoietic stem cells were studied cytogenetically and from the aspect of differentiation and proliferation, using single colonies derived from human hemopoietic stem cells. The subjects studied were A-bomb survivors in the high dose exposure group (T65D 100 + rad) with a high incidence (10 % or more) of radiation-induced chromosome abnormalities in their peripheral lymphocytes, and their controls. Examinations were performed on 21 A-bomb survivors (10 males and 11 females) and 11 controls (5 males and 6 females). Colony formation of hemopoietic stem cells (granulocyte/monocyte-colony-forming cells, GM-CFC and burst-forming unit-erythrocytes, BFU-E) was made by the methylcellulose method patterned after the methods of Iscove et al and Ogawa et al using 5 - 10 ml of peripheral blood. Chromosome specimens were prepared from single colonies by the micromethod which we have reported elsewhere. The total number of colonies analyzed in the exposed group was 131 GM-CFC and 75 BFU-E. Chromosome abnormalities were observed in 15 (11.5 %) and 9 (12.0 %) colonies, respectively. In the control group, the total number of colonies analyzed was 61 GM-CFC and 41 BFU-E, but none of the colonies showed chromosome abnormalities. A highly significant difference in chromosome abnormalities was demonstrated by an exact test with a probability of 0.3 % for GM-CFC and 1.7 % for BFU-E. The karyotypes of chromosome abnormalities obtained from the colonies of hemopoietic stem cells in the exposed group were mostly translocations, but deletion and marker chromosomes were also observed. In two individuals, such karyotypic abnormalities as observed in the peripheral lymphocytes were seen also in the hemopoietic precursor cells. This finding suggests that radiation may produce an effect even on relatively undifferentiated hemopoietic stem cells.

39690 Evaluation of a technique for separating organic material from mineral bone in individuals occupationally exposed to Pu. Miglio, J.J.; Willis, L.C. (Los Alamos National Lab., NM). *Health Physics;* No. 6, 763-767(Jun 1987).

The shaft portion of the left femur from an individual occupationally exposed to Pu was used to investigate the suitability of an ethylenediamine extraction technique to separate mineral bone from organic material. Marrow in the lumen was removed before the extraction technique was used and was analyzed separately for Pu. Ethylenediamine extraction did not remove Pu from the mineral bone, even after treatment for 48 h. The total amount and the concentration of Pu was highest in mineral bone and lowest in the extracted organic material.

39691 Radiobiology of ultrasoft X rays. I. Cultured hamster cells (V79). Raju, M.R.; Carpenter, S.G.; Chmielewski, J.J.; Schillaci, M.E.; Wilder, M.E.; Freyer, J.P.; Johnson, N.F.; Schor, P.L.; Sebring, R.J.; Goodhead, D.T. (Los Alamos National Lab., NM). *Radiation Research;* No. 3, 396-412(Jun 1987).

Ultrasoft X rays (approximately less than keV) provide a useful probe for the study of the physical parameters associated with the induction of biological lesions because the spatial scale of their energy depositions is of nanometer dimensions, comparable to that of critical structures within the cell. We report on cell-killing experiments using cultured hamster cells (V79) exposed to carbon K (0.28 keV), aluminum K (1.5 keV), copper K (8.0 keV), and 250 kVp X rays, under oxic and hypoxic conditions, and as a function of cell-cycle phase. Our principal results are: RBE increases with decreasing X-ray energy; OER decreases with decreasing X-ray energy; and cell-cycle response is similar for all X-ray energies. Our RBE results confirm earlier observations using ultrasoft X rays on mammalian cells. The shapes of fitted curves through the data for each energy are statistically indistinguishable from one another, implying that the enhanced effectiveness is purely dose modifying. The results reported herein generally support the view that single-track effects of radiation are predominantly due to very local energy depositions on the nanometer scale, which are principally responsible for observed radiobiological effects.

39692 Radiation-induced division delay in 9L spheroid versus monolayer cells. Sweigert, S.E.; Alpen, E.L. (Lawrence Berkeley Lab., Berkeley, CA). *Radiation Research;* No. 3, 473-478(Jun 1987).

The technique of percentage labeled mitoses was used to compare radiation-induced division delay in 9L rat gliosarcoma cells growing as spheroids or as exponential monolayers. The length of delay induced by each of five X-ray doses was determined as the difference between control and irradiated cultures in the time required to reach the half-height of the first peak of labeled mitoses. Spheroid cells were delayed significantly longer than monolayer cells; the slopes of the dose responses were 32 and 13 min/Gy, respectively. Cells in small spheroids (150 micron diameter) were delayed to the same extent as cells in large spheroids (800 micron diameter). Like the contact effect previously observed as enhanced radiation survival of cells grown as spheroids, the increased radiation-induced delay may be a consequence of the growth of cells in three-dimensional contact.

39693 Plutonium and lung cancer. Tietjen, G.L. (Los Alamos National Lab., NM). *Health Physics;* No. 5, 625-628(May 1987).

The National Plutonium Workers Study surveys workers at three major U.S. Department of Energy facilities who were exposed to Pu and other radioactive substances. The purpose of the

study is to measure adverse health effects, if any, which arise from exposure. Most exposures occur from inhalation of highly insoluble forms of plutonium oxide, and from animal studies, lung cancer is the most likely outcome. To date, the studies have shown that lung cancer mortality among highly exposed persons is surprisingly low when compared to national averages.

39694 **Microdosimetric concepts applied to hormesis.** Bond, V.P.; Feinendegen, L.E.; Sondhaus, C.A. (Brookhaven National Lab., Upton, NY). *Health Physics;* No. 5, 659-661(May 1987).

With radiation, unlike chemicals, a small absorbed organ dose can deliver amounts of energy to macromolecular cell targets so great that, if the relevant target is hit, even the best efforts of any repair processes probably cannot prevent cell transformation. Data are shown for both mutagenesis and carcinogenesis, indicating that, in this respect, even the smallest average organ absorbed dose can be effective, particularly for high-LET radiation. Thus while hormesis-enhanced protective processes may render ineffective marginally large amounts of energy deposition per cell target and thus perhaps reduce the incidence of carcinogenesis and mutagenesis, a goal of zero incidence is most likely unrealistic for at least high-LET radiation. The usefulness of the radiation hormesis concept may well be decided on these questions because of the general awareness that even a moderate average life lengthening in the population would not eliminate marked shortening of useful life in the young with induced cancer or serious genetic defects.

39695 **Structure-function relationships in radiation-induced cell and tissue lesions: special references to the contributions of scanning electron microscopy and hematopoietic tissue responses.** Seed, T.M. (Argonne National Lab., IL). *Scanning Miscroscopy;* No. 1, 255-272(Mar 1987).

Contributions of scanning electron microscopy to the field of radiation biology are briefly reviewed and presented in terms of an overall goal to identify and characterize the structural features of radiation-induced lesions in vital cell and tissue targets. In the context of lesion production, the major radiation-elicited response sequences, the types and nature of measured end points, and governing temporal and radiobiological parameters are discussed and illustrated by using results derived from both in vitro cell systems and in vivo studies that measured tissue responses from various organ systems (respiratory, digestive, circulatory, and central nervous systems). Work in our laboratory on the nature of early and late hematopathologic tissue responses (aplastic anemia and myeloid leukemia) induced by protracted radiation exposure and the bridging effect of repair processes relative to the expression of these pathologies is highlighted.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 38720, 39579, 39603, 39605, 39613

39696 **(DOE/ER/60076—3) Pulmonary metabolism of dibenz(a,j)acridine: A carcinogenic heterocyclic aromatic: Final report for period September 1, 1982-June 30, 1986.** Warshawsky, D. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). Jul 1987. Contract AC02-82ER60076. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012995.

The metabolism of the carcinogenic N-heterocyclic aromatic, dibenz(a,j)-acridine (DBA) was investigated in the isolated perfused lung (IPL) preparation. A significantly increased rate of metabolism was observed for DBA in benzo(a)-pyrene (BaP) and DBA-pretreated animals. This resulted in marked increases in conjugation, in particular sulfates and thioethers, and the distribution of conjugates and total metabolites in blood and lung. When Fe_2O_3 was coadministered with DBA to the IPL, the rate of metabolism was significantly decreased with respect to control experiments. This resulted in increased distributions of sulfate and thioether conjugates in blood. Spectroscopic analyses and microsomal enzyme analyses were used in the characterization of the four metabolites identified in the lung. The major nonconjugated metabolite was the 3,4 dihydrodiol of DBA and the three minor metabolites were the 4 and 3 phenol of DBA and a dihydroxy compound of DBA. The results indicate that in the lung DBA is metabolized in a manner similar to that of BaP but different from that of dibenzo-(c,g)carbazole. It is, therefore, apparent that the metabolism of N-heterocyclic aromatics are related to the aromaticity of the heteroatom-containing ring and the solubility of compound, as well as the specific enzymes responsible for activation of the compound. 115 refs., 78 figs., 24 tabs.

39697 **(KFK-PEF—10) Interdisciplinary core research site of PEF at Kaelbelescheuer/Southern Black Forest. Original data 1985.** Siefermann-Harms, D.; Kilz, E. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Feb 1987. 231p. (In German). NTIS (US Sales Only), PC A11. File Number DE87770205.

The report 'Quelldaten 1985' of the Core Research Site Kaelbelescheuer documents the status of healthy and damaged spruce and fir trees in its surroundings in the Upper Black Forest Region. Results from physiological, biochemical, histological, virological, bacteriological and mycological investigations are presented. The majority of the data stem from the year 1985. To enable comparison between different research sites, raw data are, for the most part, presented.

39698 **(NP—7770128) Trace analysis of Pb, Cd, and Cr in tissue samples of bronchial carcinoma patients using atomic absorption spectroscopy and inverse voltammetry.** Heckenkamp, J. (Freie Univ. Berlin (Germany, F.R.)). 14 Feb 1986. 89p. (In German). NTIS (US Sales Only), PC A05. File Number DE87770128.

The samples were homogenized and dried; care was taken to avoid contamination. Methods of digestion and measuring techniques were optimized for the specific problem. In the case of AAS, pressure digestion with nitric acid was the most favourable process as element losses are avoided. In Cd analysis by polarography, digestion in a quartz flask using nitric acid and perchloric acid was preferred as the base current in the measurements is very low. Polarographic measurements were possible in some instances, so that three values were available for some samples. The accuracy was 15% for Cd, 20% for Pb, and 35% for Cr.

39699 (NP—7770140, pp 1-126) **Investigation of physiological parameters of old spruces in the sites No. 109 (ridge) and No. 79 (depression) in the Hils mountains - a contribution to the quantification of hypotheses on the causes of forest die-back.** Fedderau-Himme, B.; Feig, R.; Herms, A.; Rosenplaenter, K.; Grothey, V.; Huettermann, A. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

Two stands exhibiting very different degrees of damage were compared with each other with reference to several physiologic-biochemical characteristics. The comparison was to serve the purpose of establishing the causes of forest die-back. The following characteristics were studied: water potential, leaching kinetics of electrolytes as against conductivity water, chlorophyll a, b, carotinoids, starch, prolin, acid phosphatase and peroxidase, isoenzymes of acid phosphatase, and SDS-PAGE prolin spectra. The vast data material is discussed.

39700 (NP—7770140, pp 127-168) **Investigations in young stands in the Hils mountains, No. 103 (luff-side) and 65 (lee-side).** Feig, R.; Herms, A.; Merg, G.; Grothey, V.; Huettermann, A. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

Chlorophyll fluorescence in vivo was measured in young spruce stands. This method is suitable to be used in the field and to

allow early diagnosis of forest disease. Furthermore the content of adenime nucleotides and the phosphorylation potential of the adenylate system was determined and the energy charge (AEC) calculated.

39701 (NP—7770140, pp 169-185) **Investigation of simple morphological key quantities and stress-relevant physiological parameters of the needles and roots of two 80-year-old spruces exhibiting different degrees of damage.** Eichhorn, J.; Feig, R.; Herms, A.; Grothey, V.; Merg, G.; Huettermann, A. (Hessische Forstliche Versuchsanstalt, Hann Muenden, Germany, F.R.; Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

Spruces having sustained varying degrees of damage were compared with one another. The amount of needles, needle coloration, and amount of secondary buds and shoots were evaluated. Besides the root volume, the number of fine roots was recorded. From the results the conclusion is drawn that harmful agents act primarily via the soil and only in the second place via the air. The results of the physiological investigations are listed in table form.

39702 (NP—7770140, pp 187-195) **Analysis of the plant hormones Abscisic acid and Xanthoxin in trees of the two stands No. 79 and 109 in the Hils.** Majcherczyk, A.; Huettermann, A. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

Pilca abies of two different treations were compared. The phytohormones Abscisic acid and Xanthoxin were analysed. The role and the content of abscisic acid and Xanthoxin in trees under stress induced by acid rain were investigated.

39703 (NP—7770140, pp 197-213) **Uptake and toxicity of heavy metals in Picea abies (Karst.) seedlings.** Godbold, D.L. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

The effect of the heavy metals zinc, cadmium, manganese and mercury in the soil solution on seedlings of spruce (Picea abies) was investigated. Root elongation and element uptake into roots and needles were measured. The results were discussed with the final conclusion, that heavy metals are a possible causative factor in forest die-back.

39704 (NP—7770140, pp 215-224) **Applications of gamma computerized tomography for damage detection in tree roots.** Lovas, G.; Huettermann, A.; Habermehl, A.; Ridder, H.W. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik; Marburg Univ., Germany, F.R. Medizinisches Zentrum fuer Radiologie). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

A non-destructive method for root damage assessment is described which is based on CT measurements of the water distribution in the trunk. In principle, the method is suited for detecting inactive root zones, although it has not been fully explored yet.

39705 (NP—7770140, pp 249-262) **Effects of acid precipitation on plant physiology.** Huettermann, A. (Goettingen Univ., Germany, F.R. Inst. fuer Forstbotanik). 1984. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87770140.

Berichte des Forschungszentrums Waldoekosysteme/Waldsterben.; Vol. 4.

In Reports of the Research Centre for Forest Ecosystems and Forest Damage.

A fertilization test in the forest was carried through on beech seedlings. The four modes of treatment were: no treatment (control), mixing of the humus layer with the mineral soil (B), or mixing of the humus layer plus added lime with the mineral soil (BK), and lastly planting in standard soil. The work consisted in: investigation of the morphology of the root systems, recording of soil chemism, analysis of plant constituents such as potassium, aluminium, chlorophyll, and starch. Results are discussed ariving at the conclusion that air pollutants have a harmful effect on plants both via the soil and directly.

39706 **(NP—7770140) Reports of the Research Centre for Forest Ecosystems and Forest Damage.** (Goettingen Univ. (Germany, F.R.). Forschungszentrum Waldoekosysteme - Waldsterben). 1984. 286p. (In German). NTIS (US Sales Only), PC A13. File Number DE87770140.

In ten different reports numerous scientists try to verify the reasons of forest die-back. The areas of soil chemistry, soil biology and physiology and anatomy of plants are treated. Methods are discribed in detail. A summary of the research results is given. Separate abstracts were prepared for the 9 individual papers.

39707 **(NP—7770196) Effects of air pollution on some physical properties of the spruce timber (Picea abies (L.) karst.).** Aszmutat, H. (Goettingen Univ. (Germany, F.R.). Forschungszentrum Waldoekosysteme - Waldsterben). 1986. 187p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770196.

The influence of air pollutants on the wood properties of spruce stems was investigated. The results do not show significant differences in wood quality parameters between damaged and healthy trees. There could not be found any specific symptoms of wood quality changes caused by air pollutants.

39708 **(NP—7770197) Growth and damage dynamics of spruce roots as a function of soil chemistry.** Bertiller, M.B. (Goettingen Univ. (Germany, F.R.). Forschungszentrum Waldoekosysteme - Waldsterben). 1986. 176p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770197.

The root system of two years old spruce trees and their reactions on soil chemical stress were tested in laboratory experiments. The ion content of H/sup +/, Ca/sup ++/, K/sup +/, Al/sup +++/, NH/sub 4//sup +/, concentration of anions and proportions of Ca/Al and of the NO/sub 3//NH/sub 4/ in the soil solution have been changed. The results are discussed and show, that for the discussion of soil acidification not only pH, aluminium and Ca/Al proportion are important, but also further parameters of concentrations and proportions.

39709 **(NP—7770246) Comparative investigations to determine the vitality of forest trees - a contribution to the forest decline research in the Federal Republic of Germany.** Schmuck, G.K. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Bio- und Geowissenschaften). 22 Oct 1986. 186p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770246.

This dissertation deals with different aspects of forest decline research in the Federal Republic of Germany and consists of three parts: I. Measurement of photosynthetic parameters: That damage to photosynthesis and to the photosynthetic apparatus is one of the early results of tree damage was proved in extended outdoor measurements in the Black Forest and in laboratory measurements using different methods (registration of chlorophyll-fluorescence; fluorescence induction kinetics (Rfd-values); measurement of net-photosynthesis P/sub N/ and of stomata conductivity; registration of

water-potential and pigment analyses). II. Reflection measurements (terrestrial and remote sensing): A comparison was made between a) reflection data of needle years of damaged and undamaged spruces (ground truth measurements with the VIRIS spectrometer) and b) reflection data which were gathered with the 11 channel Bendix-Scanner by aircraft overflights ('remote sensing'). III. Physiology of ozone fumigated spruce trees: Furthermore the effect of ozone on four-year old spruces was tested in closed top chambers. The fumigation experiment aimed at ascertaining whether ozone injures spruce needles visibly and whether these possible damage symptoms are similar to those in the field.

39710 (RFP—4036, pp 1-2) **Beryllium antibody detection method.** Barrick, C.W.; Clarke, S.M. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

The purpose of this study was to design and develop a method to detect antibodies specific to beryllium. Plasma and sera from five Rocky Flats Plant employees were examined for the presence of beryllium antibodies.

39711 (RFP—4036, pp 3-4) **Human erythrocyte acute toxicity assay.** Barrick, C.W.; Clarke, S.M. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

Using the human red blood cell, we developed a quick, easy, sensitive and cost effective acute toxicity assay directly related to human cells. We used a set of beryllium standards as the toxicant, and demonstrated a typical biphasic dose response curve. The assay developed could be used with other toxicants.

39712 (RFP—4036, pp 5-7) **Mechanism of beryllium toxicity.** Barrick, C.W.; Clarke, S.M. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

There are three current theories for the mechanism of beryllium toxicity. We proposed a fourth: attachment to/or destruction of adenosine triphosphate (ATP). This was based on similarity of dose response curves when beryllium was exposed to red blood cells and to purified ATP.

39713 (RFP—4036, pp 7-9) **Effects of beryllium on human blood ATP.** Barrick, C.W.; Clarke, S.M. 1 May 1987. NTIS, PC A04/MF A01. File Number DE87012301.

In HS and E application technology: Semiannual progress report, July through December 1985.

This project's purpose was to examine why individuals react differently to the same beryllium exposure. We tested 10 employees' red blood cells' reaction to standard beryllium samples. All the red blood cells reacted the same.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 39300

39714 (AD-A—179878/4/XAB) **Tissue culture and in vivo modeling of corneal opacification and ocular injuries induced by pulsed millimeter waves. Annual report (Final), 1 October 1980-31 May 1984.** Trevithick, J.R. (University of Western Ontario, London (Canada). Dept. of Biochemistry). Feb 1985. 27p. NTIS, PC A03/MF A01.

The eventual aims of these experiments were to use intact corneas incubated in vitro and corneas of rats or rabbits exposed in vivo to high-energy pulsed millimeter waves to study the development of corneal damage. Such experiments were expected (1) to establish conditions for corneal damage and (2) to elucidate the mechanisms by which the damage occurs. In order to perform these tests, studies of damage top corneas exposed to elevated temperatures in vitro are required as controls to establish a baseline. Rabbit corneas were exposed for a period of 30 minutes to elevated temperatures. Epithelial-cell changes appeared to be more pronounced than endothelial cell changes at all temperatures. Epithelial cells changed from flat cells with elevated intercellular junctions and short cylindrical microvilli increased damage was seen, including cell curling to look like potato chips, increased stromal denudation and fibrous cell surfaces. Both these changes and endothelial changes were accentuated in vitamin E-containing medium. For endothelial cells also, progressive increases in damage were seen as temperature increased: potato chip cells, some cell swelling obscuring cell boundaries, clumps, and cell processes covering cell surfaces leading to rough fibrous-cell surfaces, with many holes. Stromal changes, leading to stromal disorganization and separation into many fine individual strands, also occurred with increasing temperature.

39715 (AD-A—179987/3/XAB) **Extremely-low-frequency (elf) communications program: non-ionizing electromagnetic radiation literature evaluation and assessment; 1977-1986 literature review. Final report.** (Research and Development Labs., Culver City, CA (USA)). Nov 1986. 144p. (RDL—26). NTIS, PC A07/MF A01.

Chapter I of this report presents brief summaries for nine different and probably most-important issue areas associated with the ELF electric- and magnetic-field bioeffects. These general issue areas are: Physical Hazards Including Electric Shocks and Effects on Electronic Medical Devices, Therapuetical Effects, In Vitro Cellular Studies Including Membrane and Extracellular Interactions, In Vivo Physiological Studies Including Neural and Neuroendocrinological Effects, Metabolism, Growth, and Development, Reproductive Effects, Cancer Risk, Behavioral Effects, and Ecological Effects. The overall conclusion at the end of Chapter I integrates all of the summaries into one compact statement on the status of current scientific knowledge of possible effects on living systems exposed to ELF electric and magnetic fields. A detailed description of the developed ELF bioeffects libraries, including data-base computer-file features and operation, is presented in Chapter II. Chapter III presents details on the review, evaluation, and assessment procedures. Chapter IV presents a more thorough discussion of the evaluated and assessed literature used in preparation of the summary in Chapter I. The review is confined to the same categories and order as those outlined in Chapter I.

39716 (AD-A—180107/5/XAB) **Metabolic and vasomotor responses of rhesus monkeys exposed to 225-MHz radiofrequency energy.** Lotz, W.G.; Saxton, J.L. (Naval Aerospace Medical Research Lab., Pensacola, FL (USA)). 1987. 18p. (NAMRL-OL—87-2). NTIS, PC A02/MF A01.

Pub. in Bioelectromagnetics, Vol. 8, 73-89(1987).

A previous study showed a substantial increase in the colonic temperature of rhesus monkeys (Macaca mulatta) exposed to radio-frequency (RF) fields at a frequency near whole-body resonance and specific absorption rates (SAR) of 2 to 3 W/kg. The present experiments were conducted to determine the metabolic and vasomotor responses during exposures to similar RF fields. Five adult male rhesus monkeys were exposed to 225-MHz radiation (E orientation) in an anechoic chamber. The monkeys were irradiated at two carefully-controlled ambient temperatures, either cool (20 C) or thermoneutral (26 C). Power densities ranged from 0 (sham) to 10.0 mW/sq cm with an average whole-body SAR of 0.285 (W/kg)/(mW/sq cm). Two experimental protocols were used, each of which began with a 120-min preexposure equilibration period. Then, one protocol involved repetitive 10-min RF exposures at successively higher power densities with a recovery period between exposures. In the second protocol, a 120-min RF exposure permitted the measurement of steady-state thermoregulatory responses. Metabolic and vasomotor adjustments in the rhesus monkey exposed to 225 MHz occurred during brief or sustained exposures at SARs at or above 1.4 W/kg. Metabolic and vasomotor responses were coordinated effectively to produce a stable deep-body temperature. The results show that the thermoregulatory response of the rhesus monkey to an RF exposure at a resonant frequency limits storage of heat in the body. However, substantial increases in colonic temperature were not prevented by such responses, even in a cool environment.

39717 (AD-A—180132/3/XAB) Low-noise amplifier for use with submillimeter electric-field probes. Final report. Pavlica, S. (Army Military Personnel Center, Alexandria, VA (USA)). May 1987. 94p. NTIS, PC A05/MF A01.

In the past several years, there has been increasing concern over the effects on human beings of low level electromagnetic radiation. Submillimeter electric field probes were developed to directly measure E fields in biological media. These probes are also very useful for measuring E fields in cavities where solving the mathematical equations, because of the geometries of the cavities, is very difficult or impossible. An amplification system for these probes is investigated. This system is designed, built, and laboratory tested. A theoretical gain equation is developed relating the output voltage of the system to the impinging E field on the probe. Additionally, a complete noise analysis is accomplished. Theoretical noise work is verified in the laboratory, along with the gain equation. Finally, modulation of the probe amplifier system is shown to be feasible and is demonstrated in the laboratory. This will allow the measurement of the relative phase shift between two points in a cavity.

57 Health And Safety

REFER ALSO TO CITATION(S) 38851, 39016, 39364

58 GEOSCIENCES

REFER ALSO TO CITATION(S) 39550

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 38614, 38625

39718 (DOE/ER/60472—1) Remote sensing and hydrologic modeling in arid watersheds: A scale analysis: Progress report. McDonnell, A.J. (Pennsylvania State Univ., University Park (USA). Environmental Resources Research Inst.). Jun 1987. Contract FG02-86ER60472. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011623.

Research has included field work at Walnut Gulch and Plutonium Valley, acquisition of all remotely sensed data sets, and initial analysis of those data sets. Data collected included soil infiltrometer tests on major soil series at Walnut Gulch for quantification of soil runoff characteristics, soil texture analyses, and grain size analysis for major channel segments of Walnut Gulch. Field work also included preliminary surficial mapping at Plutonium Valley. These data will be used to evaluate soil and channel hydrologic characteristics for training remotely sensed data and for input into the SPUR hydrologic model. The first phase of the field survey has been successfully completed.

39719 (DOE/ET/27014—2) Geologic map of the Hood River Quadrangle, Washington and Oregon. Korosec, M.A. (comp.). (Washington State Dept. of Natural Resources, Olympia (USA). Div. of Geology and Earth Resources). 1987. Contract AC07-79ET27014. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012414.

The report is comprised of a 1:100,000 scale geologic map and accompanying text. The text consists of unit descriptions, a table of age dates, a table of major element geochemistry, correlation diagram, and a source of mapping diagram. (ACR)

39720 (DOE/ET/27014—3) Geologic map of the Mount Adams Quadrangle, Washington. Korosec, M.A. (comp.). (Washington State Dept. of Natural Resources, Olympia (USA). Div. of Geology and Earth Resources). 1987. Contract AC07-79ET27014. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012413.

This report is comprised of a 1:100,000 scale geologic map and accompanying text. The text consists of unit descriptions, a table of age dates, a table of major element geochemistry, correlation diagram, and a source of mapping diagram. (ACR)

39721 (INIS-BR—627) Behavior of Rb-Sr isotope system: examples of the east of the San Francisco craton, problems and implications. Sa, E.F.J. de; Kawashita, K. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702462.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39722 (INIS-BR—628) Rb/Sr and K/Ar rock determination of Monguba and Pendanga stone pit (Maracanau and Guaramiranga Municipal district - Ceara - Brazil). Torquato, J.R.F.; Kawashita, K.; Barbosa, H.S.P.; Pedreira, L.H. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702463.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39723 (INIS-BR—629) Geochronological study of the lower part of Sao Roque group. Schmus, W.R. Van; Cordani, U.C. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—3-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702464.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39724 (INIS-BR—630) New U-Pb geochronological data for the archean rocks from Amparo complex. Wernick, E.; Oliveira, M.A.F. de. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—4-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702465.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39725 (INIS-BR—646) Studies of fission tracks in a well at Espirito Santo Basin, Brazil. Poupeau, G.R.J.; Baitelli, R.; Guimaraes, P.P.D.; Khouri, M.T.F.C. (Instituto Brasileiro de Petroleo, Rio de Janeiro). 1986. 1p. (In Portuguese). (CONF-861048—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702481.

From 3. Brazilian petroleum congress; Rio de Janeiro, Brazil (5 Oct 1986).

39726 (OAEP—87) OAEP Natural radiocarbon measurements-1. Siri-upatham, C.; Sonsuk, M. (Office of Atomic Energy for Peace, Bangkok (Thailand)). Dec 1978. 18p. (In Thai). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702537.

The method which is based on the transformation of the specimens to benzene with subsequent counting by a liquid scintillation counter has been used to measure the C-14 activity. The list includes dating determinations of archaeological and geological specimens submitted by the Department of Fine Arts, the Faculty of Fine Arts and the Department of Mineral Resources since 1976. The maximum age limit obtainable by the available counter is 36,000 years with a statistical variation of 3 sigma. C-14 activity in the leaves and roots of the annual crops exchange with the troposphere in the year 1977 and 1976 is found by the experiment to be about 130 pmc. 20 references.

39727 (PNL-SA—14861) Scale-dependent effective dispersion coefficients for one-dimensional solute transport. Simmons, C.S.; Kincaid, C.T. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 17p. (CONF-8704169—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011987.

From 7. annual AGU Front Range Branch hydrology days conference; Fort Collins, CO, USA (21 Apr 1987).

A stochastic-convective model for solute transport is used to explain scale-dependent dispersion in a restricted, one-dimensional domain, $x > 0$. The model uses the concept of an ensemble of random velocities to describe transport under steady-state, uniform flow conditions. Using the concept of a velocity ensemble, ex-

pressed in terms of a probability density function (pdf) of the random transport velocity for each representation, two effective dispersion coefficients (D) are obtained in terms of velocity statistics for the ensemble. Scale-dependent dispersion occurs when D increases in proportion to either distance, x, or time, t. By solving the conventional convective-dispersion equation with $D = Kt$ (Lagrangian case) and $D = \lambda x$ (Eulerian case), where K and λ are related to statistical parameters of velocity, we show that these expressions for D represent two different velocity ensembles. The ensembles both have pdfs of velocity that are invariant and independent of x and t.

5802 Geophysics

39728 **(INIS-mf—10632) 46. annual meeting of the Deutsche Geophysikalische Gesellschaft e.V. Joint symposium of the ILP/SFB 108 on the continental lithosphere - structure, composition and processes.** (Deutsche Geophysikalische Gesellschaft e.V., Hamburg (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 108 Spannung und Spannungsumwandlung in der Lithosphaere). 1986. 253p. (In German and English). (CONF-8604322—). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752245.

From 46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes; Karlsruhe, F.R. Germany (7 Apr 1986).

198 papers were read on continental lithosphere investigations. Physical, and especially seismic methods were given particular attention. Geothermal exploration, safety studies on salt strata, and the identification of nuclear weapons tests were gone into. Separate records are available for 22 papers.

39729 **(NUREG/CR—4973) Intraplate seismicity outside of the United States.** Schweitzer, J.; Glover, L. III. (Virginia Polytechnic Inst., Blacksburg (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 86p. NTIS, PC A05/MF A01 - GPO. File Number TI87900902.

A survey of intraplate seismicity in eastern Canada, Australia, and western Europe was undertaken. Eastern Canada has been divided into four seismic zones; namely, LaMalbaie (Quebec), western Quebec, New Brunswick, and Baffin Island. Australia, a relatively aseismic continent surrounded by very seismically active areas, has been divided into three seismic zones, western Australia, south Australia and eastern Australia. Intraplate seismicity in western Europe is concentrated in central and northern Europe. Based on this survey, several general observations about intraplate seismicity can be made. Much of the seismic activity in these intraplate regions is relatively shallow and is frequently localized in basement rocks. Seismic events are frequently attributed to movement along pre-existing faults, although surface faulting rarely accompanies these earthquakes. Paleo-rift zones seem to be particularly susceptible to reactivation. Plate interactions and asthenosphere drag both play a role in development of a regional horizontal maximum principal compressive stress, but the actual triggering mechanism and localization cause for this fault reactivation in intraplate regions is still only poorly understood.

5803 Mineralogy, Petrology, And Rock Mechanics

39730 **(CONF-870625—16) Behavior of a wide opening in a deep potash mine: A case history.** Hambley, D.F.; Mraz, D.Z. (Argonne National Lab., IL (USA); Mraz Project Consultants Ltd., Saskatoon, Saskatchewan (Canada)). 1987. Contract W-31109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011443.

From Rock mechanics meeting; Tucson, AZ, USA (29 Jun 1987).

This paper presents the case history of a monitored opening 4.5 m high by 42 m wide in a deep potash mine. Deformations and stresses were measured in the roof and a wall. From the monitoring data, the geometry of the active opening and viscoplastic zone was determined and compared with predicted values. Reasonable agreement between measured and predicted values was obtained. Using the data, the projected mining layout of relatively thick pillars with viscoelastic zones was evaluated and found to be satisfactory.

39731 **(INIS-BR—642) Localization of zirconium in bauxite of Lages, Santa Catarina, Brazil.** Cesbron, F.; Formoso, M.L.L.; Goni, J.; Melfi, A.J. (Sociedade Brasileira de Geologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8610278—16-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702477.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

39732 **(LA—11011-MS) Acoustic Data Acquisition System (ADAS) for studying acoustic emissions and elastic wave velocities in rock.** Kranz, R.L.; Stafford, D.; Kernodle, A.K.; House, L. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012697.

A high-speed, flexible data acquisition system was developed for the purpose of digitally recording waveforms from acoustic emissions generated by microcracks in rock samples and for making periodic measurements of acoustic velocity in the rock. The system is operated through specially designed, easy-to-use, menu-driven software, which runs on a Digital Equipment Corporation LSI-11 computer interfaced with a variety of CAMAC acquisition and control modules. The system can accept up to 8 transducer inputs and digitize at rates up to 32 million samples per second. It can selectively discriminate and count up to 6600 acoustic emission "events" per second while archiving full digitized waveforms from all 8 inputs at a rate of between 5 and 15 events per second. Automatic input pulse capability also allows time-of-flight measurements between all transducers in the array for acoustic velocity calculations. The system includes the capability of quasi-real-time histogramming of event rates and continuous display of system status, experiment times, discrimination thresholds, and stored event counts.

5804 Geochemistry

REFER ALSO TO CITATION(S) 39618

5805 Oceanography

39733 **(DOE/ER/60376—2) Shelf export of particulates/transport in continental margin waters (SEPTIC): Progress report for the period September 15, 1986-June 30, 1987.** Pietrafesa, L.J. (North Carolina State Univ., Raleigh (USA). Dept. of Marine, Earth and Atmospheric Sciences). Jun 1987. Contract FG09-85ER60376. 46p. NTIS MF A01; 2; GPO Dep. File Number DE87012237.

The physical oceanographic objectives of SEEP are to identify possible pathways of exchange of particulate matter between the shelf and continental slope as these processes relate to the biological objectives of the determination of the processes governing the production and fate of biogenic particles and the chemical objectives of partitioning the natural and contaminant chemical species between dissolved and particulate phases. During the present funding period, research activities have been directed towards: publishing the results of SEEP-I; publishing further results from NCSU's South Atlantic Bight studies; designing and constructing four cages which will house the RD-Acoustic Doppler Current Profilers including one to be used in SEEP-II by the BNL and three to be used by NCSU; calibrating all current meters, thermister chains and conductivity pressure and temperature sensors for SEEP-II; determining the temporal and spatial scales of physical processes observed during SEEP-I in preparation for finalizing the mooring positions and sampling intervals for SEEP-II.

39734 **(NP—7770158) Basis of oceanography. Textbook to the 'Atlas of oceanography'.** Ulrich, J. (Naturwissenschaftlicher Verein fuer Schleswig-Holstein, Kiel (Germany, F.R.); Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde). 1986. 196p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770158.

This volume was divided into four main chapters, but the further sub-division was done analogous to that of an atlas of oceanography, so that the reader can quickly find his/her way. There may be more recent representations for some of the aspects dealt with here, but the general information from the illustrations, which can only have the character of examples for certain conditions, conjuctions and processes in the sea, will not have changed.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 39922, 40136

39735 **(ANL-HEP-CP—87-36) A measurement of the angular resolution of air showers using the muonic component at ground level.** Goodman, M.C.; Ellsworth, G.B.; Bofill, J.; Bogert, D.; Freudenreich, H.; Goodman, J.A.; Busza, W.; Eldridge, T.; Abolins, M.; Gupta, S.C. (Argonne National Lab., IL (USA); George Mason Univ., Fairfax, VA (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Maryland Univ., College Park (USA); Massachusetts Inst. of Tech., Cambridge (USA); Michigan State Univ., East Lansing (USA)). 1987. Contract W-31109-ENG-38. 5p. (CONF-870855—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011493.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The angular resolution of cosmic ray air showers is found to be 13.4 mr using single tracks and as good as 2 to 4 mr from all of the tracks for selected events by using the muonic component of air showers and a fine grained calorimeter. The sample of events was 8776 events triggered by an air shower array in which 3 to 76 muons were reconstructed. There was very little dependence of the single track angular resolution on either the number of muons or the shower angle.

39736 **(BARC—1309) Gulmarg estimate of PeV photon flux from Cygnus X-3 and its relevance.** Bhat, C.L.; Sapru, M.L.; Razdan, H. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702422.

An analysis of atmospheric Cerenkov pulses recorded during January 1976 - December 1977, by a wide-angle photomultiplier system at Gulmarg (India), reveals a phase-dependent component exhibiting the characteristic Cygnus X-3 modulation period of 4.8h. Its amplitude, given by the number of excess events in the phase peak relative to the total phase-independent events, is found to be (1.8 +- 0.4)per cent, corresponding to a detected average flux of (1.6 +- 0.4) x 10/sup -12/ $\gamma cm^{-2}s^{-1}$ above 0.5 PeV (1PeV = 10/sup 15/eV). Taken together with the spectral data for the following years from several other experiments, there is the suggestion of a long-term reduction in the luminosity of the PeV source by a factor of — 1.5 y^{-1} (exponential decay law with a time constant of — 2.3y). This intriguing possibility is further strengthened by an examination of the Haverah Park phase-histograms of Cygnus X-3 for the period January 1979 to December 1984 and the Plateau Rosa data recorded between December 1981 - March 1985, which display analogous long-term behaviour at $> 10^{15}$ eV and $> 2 \times 10^{13}$ eV respectively. After accounting for losses in the PeV photon beam due to γ-γ interactions with the 2.7deg K microwave background, a comparison of the ultra high energy photon fluxes from Cygnus X-3 with those in 10^{11} - 10^{12} eV energy region shows that the latter are significant by lower. This suggests that the TeV photons undergo servere circumstellar absorption through interactions with optical/infrared photons or/and have a production spectrum which differs in some significant manner from the one responsible for generating the PeV flux.

39737 **(BNL—39602) Variations in the solar neutrino flux.** Davis, R. Jr.; Cleveland, B.T.; Rowley, J.K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Astronomy and Astrophysics; Los Alamos National Lab., NM (USA); Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-870855—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008376.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

Observations are reported from the chlorine solar neutrino detector in the Homestake Gold Mine, South Dakota, USA. They extend from 1970 to 1985 and yield an average neutrino capture rate of 2.1 +- 0.3 SNU. The results from 1977 to 1985 show an anti-correlation with the solar activity cycle, and an apparent increased rate during large solar flares. 18 refs., 2 figs.

39738 **(BNL—39780) Supernova theory and 1987a (Shelton).** Kahana, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-8703136—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010440.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

The fortunate occurrence of supernova (Shelton) 1987a has provided a very good excuse for describing supernova theory to the general public and also, of course, for discussing neutrino properties. A brief statement on present facts about 1987a and some reference to the theory of the prompt mechanism is given. 30 refs., 4 figs., 2 tabs.

39739 **(DOE/ER/10719—4) Research in astrophysics: Stellar collapse and supernovae: Termination report, August 1, 1980-November 30, 1986.** Burrows, A.; Lattimer, J.M.; Mazurek, T.J.; Yahil, A. (State Univ. of New York, Stony Brook (USA)). [1987]. Contract AC02-80ER10719. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010378.

The interaction between nuclear theory and some outstanding problems in astrophysics has been examined. The chief emphasis of the program was on stellar collapse, Type II supernovae and neutron star formation. Central to these topics are the development of an equation of state of hot, dense matter and numerical simulations of gravitational collapse and neutron star birth. The LLPR compressible liquid drop model is the basis of the former. It has been refined to include curvature corrections to the surface energy and nuclear force parameters which are in better agreement with experimental quantities. Numerically optimized versions were used in supernova simulations. Such studies of the equation of state can also be used to analyze intermediate energy heavy ion collisions, which, in turn, may illuminate the nucleon-nucleon force. A novel hydrodynamical code in which shocks are treated via Riemann resolution rather than with artificial viscosity was developed. We modeled not only the stellar collapse leading up to a supernova, but also the quasi-static deleptonization and cooling of the nascent neutron star. For the latter evolution we also used a hydrostatic code with detailed neutrino transport. Our studies of neutrinos in stellar collapse and neutron star formation concentrated on their detectability and signatures, as neutrinos are the only direct probe of collapse and early supernova dynamics. The neutrino signatures seen from SN1987a are in complete accord with the predictions our group has been making since 1982. Complementary studies included modeling nucleosynthesis and the accretion process in quasars, and investigating the influence of galaxy clustering on the large scale structure of the universe. The last study might impose constraints on high energy theories, such as those of inflation and GUT, which can now only be tested astrophysically. 38 refs.

39740 **(FNAL/Pub—87/69-A) Can bulk viscosity drive inflation?.** Pacher, T.; Stein-Schabes, J.A.; Turner, M.S. (Fermi National Accelerator Lab., Batavia, IL (USA); Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Roland Eoetvoes Univ., Budapest (Hungary). Inst. for Theoretical Physics; Chicago Univ., IL (USA). Enrico Fermi Inst.). Apr 1987. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009650.

Contrary to other claims, we argue that, bulk viscosity associated with the interactions of nonrelativistic particles with relativistic particles around the time of the grand unified theory (GUT) phase transition cannot lead to inflation. Simply put, the key ingredient for inflation, negative pressure, cannot arise due to the bulk viscosity effects of a weakly-interacting mixture of relativistic and nonrelativistic particles. 13 refs., 1 fig.

39741 (INIS-mf—10911, pp 95) **Astrophysical importance of nuclear reaction rate measurements.** Sargood, D.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39742 (INIS-mf—10911, pp 42) **Cosmic rays with energies greater than 10 EeV.** Winn, M.M.; Ulrichs, J.; Peak, L.S.; McCusker, C.B.A. Horton. L. (Sydney Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39743 (INIS-mf—10911, pp 90) **Fly's Eye - a scintillating view of the cosmos.** Gerhardy, P.R. (Sydney Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39744 **(ITEF—47(1986)) Theory of supernovae explosion.** Blinnikov, S.I.; Lozinskaya, T.A.; Chugaj, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702508.

A review of the modern status of theories attempting to explain the development and the outcome of supernova outbursts is given. Using crude estimates it is shown how conditions for explosive instability may arise in the course of stellar evolution. Thermonuclear mechanism and core collapse calculations for supernova are considered. According to modern data the thermonuclear explosion of degenerate hydrogenless stars with total flying and substance can explain the 1 type supernovae. The collapse of a massive star core with a hydrogen shell can explain the 2 type supernovae. 82 references.

39745 **(LA-UR—87-1793) First polymer in Comet Halley: Polyoxymethylene.** Huebner, W.F.; Boice, D.C.; Sharp, C.M. (Los Alamos National Lab., NM (USA); Southwest Research Inst., San Antonio, TX (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8704138—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010139.

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The RPA2-Positive Ion Cluster Composition Analyser (PICCA) on the Giotto spacecraft detected five mass peaks with regular spacing of about 15 amu up to about 120 amu. Starting at about 45 amu, the peaks decrease in intensity with increasing mass. Within their half-width they are in good agreement with dissociation products of formaldehyde polymer (POM). We suggest a production sequence in which cosmic radiation formed POM from water and carbon monoxide on grains that were aggregated into cometisimals. Other polymers, possibly containing CN, may also exist. Observations suggest that at least some of the H-, C-, and O-containing dust particles detected by the Particle Impact Analyser (PIA) on board of the Giotto spacecraft and its equivalent (PUMA) on the Vega 1 and 2 spacecraft contain POM. The properties of POM are consistent with many of the unexpected observations in the coma. 22 refs., 4 figs., 1 tab.

39746 **(LA-UR—87-1995) ^{10}Be profiles in lunar surface rock 68815.** Nishiizumi, K.; Imamura, M.; Kohl, C.P.; Nagai, H.; Kobayashi, K.; Yoshida, K.; Yamashita, H.; Reedy, R.C.; Honda, M.; Arnold, J.R. (California Univ., San Diego, La Jolla (USA). Dept. of Chemistry; Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study; Nihon Univ., Tokyo. Coll. of Humanities and Sciences; Tokyo Univ. (Japan). Research Center for Nuclear Science and Technology; Tokyo Univ. (Japan). Faculty of Science; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 26p. (CONF-870396—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011776.

From Lunar and planetary science conference; Houston, TX, USA (16 Mar 1987).

Cosmic ray produced ^{10}Be (t/sub 1/2/ = 1.6 x 10^6 years) activities have been measured in fourteen carefully ground samples of lunar surface rock 68815. The ^{10}Be profiles from 0 to 4 mm are nearly flat for all three surface angles measured and show a very slight increase with depth from the surface to a depth of 1.5 cm. These depth profiles are in contrast to the SCR (solar cosmic ray) produced ^{26}Al and ^{53}Mn profiles measured from these same samples. There is no sign of SCR produced ^{10}Be in this rock. The discrepancy between the data and the Reedy-Arnold theoretical calculation (about 2 dpm ^{10}Be/kg at the surface) can be explained in two ways: (1) the low energy proton induced cross sections for ^{10}Be production from oxygen are really lower than those used in the calculations or, (2) compared to the reported fits for ^{26}Al and ^{53}Mn, the solar proton spectral shape is actually softer (exponential rigidity parameter Ro less than 100 MV), the omnidirectional flux above 10 MeV is higher (more than 70 protons/cm^2 s), and the erosion rate is higher (greater than 1.3 mm/My). ^{10}Be, as a high energy product, is a very useful nuclide for helping to obtain the SCR spectral shape in the past. 23 refs., 3 figs., 1 tab.

39747 **(LA-UR—87-2010) Nonradial pulsations of hot evolved stars.** Starrfield, S.G. (Arizona State Univ., Tempe (USA). Dept. of Physics and Astronomy; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-8706143—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011773.

From IAU colloquium 95; Tucson, AZ, USA (1 Jun 1987).

There are three classes of faint blue variable stars: the ZZ Ceti variables (DAV degenerate dwarfs), the DBV variables (DB degenerate dwarfs), and the GW Vir variables (DOV degenerate dwarfs). None of these classes of variable stars were known at the time of the last blue star meeting. Observational and theoretical studies of the ZZ Ceti variables, the DBV variables, and the GW Vir variables have shown them to be pulsating in nonradial g-modes. The cause of the pulsation has been determined for each class of variable star and, in all cases, also involves predictions of the stars envelope composition. The predictions are that the ZZ Ceti variables must have pure hydrogen surface layers, the DBV stars must have pure helium surface layers, and the GW Vir stars must have carbon and oxygen rich surface layers with less than 30% (by mass) of helium. Given these compositions, it is found that pulsation driving occurs as a result of the kappa and gamma effects operating in the partial ionization zones of either hydrogen or helium. In addition, a new driving mechanism, called convection blocking, also occurs in these variables. For the GW Vir variables, it is the kappa and gamma effects in the partial ionization regions of carbon and oxygen. 45 refs.

39748 **(LA-UR—87-2132) Period spacings in PG 1159-035 models.** Cox, A.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-8706143—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011744.

From IAU colloquium 95; Tucson, AZ, USA (1 Jun 1987).

The 8 periods of hot pre-white dwarf nonradial pulsator, PG 1159-035, has been used for stellar seismology to probe its internal structure.

39749 **(LBL—23302) A measurement of the low frequency spectrum of the cosmic microwave background radiation.** Levin, S.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011212.

As part of a larger effort to measure the spectrum of the Cosmic Background Radiation (CBR) at low frequencies, the intensity of the CBR has been measured at a frequency of 1.410 GHz. The measurement was made by comparing the power received from the sky with the power received from a specially designed cooled calibration target with known properties. Sources of radiation other than the CBR were then identified and subtracted to calculate the antenna temperature of the CBR at 1.410 GHz. The instrument used to measure the CBR was a total-power microwave radiometer with a 25 MHz bandwidth centered at 1.410 GHz. The radiometer had a noise temperature of 80 K, and sufficient data were taken that radiometer noise did not contribute significantly to the total measurement error. The sources of error were predominantly systematic in nature, and the largest error was due to uncertainty in the reflection characteristics of the cold-load calibrator. Identification and subtraction of signals from the Galaxy (0.7 K) and the Earth's atmosphere (0.8 K) were also significant parts of the data reduction and error analysis. The brightness temperature of the Cosmic Background Radiation at 1.410 GHz is 222. +- 0.55 Kelvin. The spectrum of the CBR, as determined by this measurement and other published results, is consistent with a blackbody spectrum of temperature 2.741 +- 0.016. Constraints on the amount by which the CBR spectrum deviates from Planck spectrum are used to place limits on energy releases early in the history of the universe. 55 refs., 25 figs., 8 tabs.

39750 **(LBL—23373) Role of pions and hyperons in neutron stars and supernovae.** Glendenning, N.K. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 4p. (CONF-870413—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012033.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

Neutron stars are studied in the framework of nuclear relativistic field theory. Hyperons and pions significantly soften the equation of state of neutron star matter at moderate and high density. We conjecture that they are responsible for the softening that is found to be crucial to the bounce scenario in supernova calculations. Hyperons reduce the limiting mass of neutron stars predicted by theory by one half solar mass or more, which is a large effect compared to the range in which theories of matter predict this limit to fall. 6 refs., 2 figs.

39751 **(N—87-20871) Coronal and prominence plasmas.** Poland, A.I. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Dec 1986. 435p. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—). NTIS, PC A19/MF A01.

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Various aspects of solar prominences and the solar corona are discussed. The formation of prominences, prominence diagnostics and structure, prominence dissappearance, large scale coronal structure, coronal diagnostics, small scale coronal structure, and non-equilibrium/coronal heating are among the topics covered.

39752 (N—87-20871, pp vp) **Some crucial corona and prominence observations.** Tandberg-hanssen, E.A. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A number of theories and hypotheses are currently being developed to explain the often complex behavior of corona and prominence plasmas. In order to test the theories and hypotheses certain crucial observations are necessary. Some of these observations are examined and a few conclusions are drawn. Corona mass balance, corona and prominence classifications, prominence formation and stability, and coronal mass ejection are dicussed.

39753 (N—87-20871, pp vp) **Heating of the stellar corona.** Parker, E.N. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The present state of development of the theory of coronal heating is summarized. Coronal heating is the general cause of stellar x-ray emission, and it is also the cause of stellar mass loss in most stars. Hence a quantitive theory of coronal heating is an essential part of x-ray astronomy, and the development of a correct theory of coronal heating should be a primary concern of x-ray astronomers. The magnetohydrodynamical effects involved in coronal heating are not without interest in their own right, representing phenomena largely unknown in the terrestrial laboratory. Until these effects can be evaluated and assembled into a comprehensive theory of coronal heating for at least one star, the interpretation of the x-ray emissions of all stars is a phenomenological study at best, based on arbitrary organization and display of x-ray luminosity against bolometric luminosity, rotation rate, etc. The sun provides the one opportunity to pursue the exotic physical effects that combine to heat a stellar corona.

39754 (N—87-20871, pp vp) **Formation and support of prominence.** Forbes, T.G. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A short introduction is given to the concepts discussed by the group on the formation and support of prominences. Only quiescent and long-lived active region prominences were considered, since transient prominence phenomena, such as sprays, surges, H alpha flare-loops, and coronal rain, are dynamically distinct from long-lived, prominences. Stable prominences (which are often referred to as filaments when seen against the disk) can be subdivided into three categories, namely active region prominences, quiescent prominences and polar crown prominences. The third category is closely related to the second since a quiescent prominence will eventually evolve into a polar crown prominence if it lasts long enough. The distinction between the first and second categories is not sharp either since intermediates exist here as well (Martin, 1973).

39755 (N—87-20871, pp vp) **Growth of radiative filamentation modes in sheared magnetic fields.** Vanhoven, G. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Observations of prominences show them to require well-developed magnetic shear and to have complex small-scale structure. Researchers show here that these features are reflected in the results of the theory of radiative condensation. Researchers studied, in particular, the influence of the nominally negligible contributions of perpendicular (to B) thermal conduction. They find a large number of unstable modes, with closely spaced growth rates. Their scale widths across B show a wide range of longitudinal and transverse sizes, ranging from much larger than to much smaller than the magnetic shear scale, the latter characterization applying particularly in the direction of shear variation.

39756 (N—87-20871, pp vp) **Can prominences form in current sheets.** Malherbe, J.M.; Forbes, T.G. (New Hampshire Univ., Durham). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Two-dimensional numerical simulations of the formation of cold condensations in a vertical current sheet have been performed using the radiative, resistive MHD equations with line-tied boundary conditions at one end of the sheet. Prominence-like condensations are observed to appear above and below an x-line produced by the onset of the tearing-mode instability. Cooling in the sheet is initiated by Ohmic decay, with the densest condensations occurring

in the region downstream of a fast-mode shock. This shock, which is due to the line-tied boundary conditions, terminates one of the two supermagnetosonic reconnection jets that develop when the tearing is fully developed. The condensation properties of shock waves, which may trigger or considerably enhance the conditions for thermal condensation are emphasized.

39757 (N—87-20871, pp vp) **Condensation modes in magnetized plasmas.** An, C.H. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Condensation modes in magnetized cylindrical plasmas, with concentration on how magnetic field affects the stability, were studied. It is found that the effects of magnetic field (shear, twist, and strength) on the condensation modes are different depending on the wave vector. For modes whose wave vector is not perpendicular to magnetic field lines the plasma motion is mainly along the field lines; the effects of magnetic field on the modes are negligible except on the heat flow parallel to the field line. For a mode which is localized near a surface where the wave vector is perpendicular to the field line, the plasma moves perpendicular to the line carrying the field line into the condensed region; magnetic field affects the mode by building up magnetic pressure in the condensed region. The stability of condensation modes strongly depends on how density and temperature vary with field twist. The stable nature of global quiescent prominence magnetic configurations implies that prominences form for low field twist for which ideal MHD modes are stable; plasma temperature should increase with field twist for stable prominence formation.

39758 (N—87-20871, pp vp) **Filament formation due to photospheric shear.** Wu, S.T.; Xiao, Y.C. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Recently, Wu, et al., (1983, 1986) developed a three-dimensional, time-dependent axisymmetric ideal magnetohydrodynamic (MHD) model which has been used to study lower solar atmospheric response due to photospheric motion. They have shown that various observed solar features can be formed from these numerical simulation experiments. Some work currently in progress which has resulted from a specific numerical simulation experiment is reported. These results may elucidate the possible physical mechanism of formation of filament.

39759 (N—87-20871, pp vp) **Formation of active region and quiescent prominence magnetic field configurations.** An, C.H.; Bao, J.J.; Wu, S.T. (Alabama Univ., Huntsville). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

To investigate the formation of prominences, researchers studied chromospheric mass injection into an overlying coronal dipole magnetic field using a 2-D ideal magnetohydrodynamic (MHD) numerical model. Researchers propose that active region prominences are formed by chromospheric plasmas injected directly into the overlying coronal magnetic field and that quiescent prominences are formed by plasmas evaporated at the interface between spicules and corona. Hence, for the simulation of an active region prominence magnetic field we inject the mass from one side, but use a symmetric mass injection to form a quiescent prominence field configuration. Researchers try to find optimum conditions for the formation of Kippenhahn-Schuluter(K-S)type field configuration for stable support of the injection plasmas. They find that the formation of K-S type field configuration by mass injection requires a delicate balance between injection velocity, density, and overlying magnetic fields. These results may explain why a prominence does not form on every neutral line.

39760 (N—87-20871, pp vp) **Numerical simulations of a siphon mechanism for quiescent prominence formation.** Poland, A.I.; Mariska, J.T.; Klimchuk, J.A. (Naval Research Lab., Washington, DC). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Quiescent prominences represent a significant challenge to our understanding of the flow of mass and energy in the outer layers of the solar atmosphere. A small number of quiescent prominences contain as much mass as the entire corona (Athay, 1976). The problem then is how to get that much material into the relatively small volume of a prominence and maintain it at a temperature of 10,000 K in close proximity to material at one million K. The thermal insulation to conduction provided by the magnetic field explains the disparate temperatures. The mass source problem is less well understood. One method for supplying mass to the prominence is to siphon it from the chromosphere. The siphon mechanism begins with a magnetic loop that evolves into a configuration with a gravitational well, such as that described by Kippenhahn and Schluter (1957). This could be formed, for example, by a twist in the magnetic field. A gravitational well could also be formed by a condensation induced sag in the field. This could further enhance the condensation process. Once this well has formed, or as it is forming, the material in the well area of the loop must cool and condense to the point where radiative losses exceed any heat input. Additional material must also flow into the well from the underlying chromosphere to supply the mass required to form the prominence. One example from a series of numerical simulations that were performed to study the formation of quiescent prominences is presented.

39761 (N—87-20871, pp vp) **Alfven-wave dissipation: a support mechanism for quiescent prominences.** Jensen, E. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

High resolution filtergrams or spectrograms of the main body of quiescent prominences often show a very vivid dynamical picture that cannot be reconciled with static models. Even if large differences exist between individual prominences in this respect, at least parts of the prominence are usually found to be in a choppy, turbulent state. Evidence for systematic flows are found in local regions in the prominence and also in the transition zone in the surroundings. These two regions are probably decoupled magnetically. Alfven waves are generally believed to be responsible for the heating in the upper chromosphere and corona (Hollweg 1986). Since evidence for the presence of Alfven waves has also been found in the solar wind field, it is highly probable that such waves are generated in the convection zone of the sun and propagated outwards in the solar atmosphere wherever a proper magnetic field is present to carry the waves. The most basic magnetic formations in the solar atmosphere are simple loops. They occur all over the solar surface and cover a large range of magnetic field strengths. Loops with the strongest magnetic fields are found in active regions. It is to be expected that the Alfven-wave flux which is channelled into the loops from below, could show considerable variation both with heliocentric latitude, with time and locally between neighbouring loops. What happens when a magnetic loop is exposed to the appropriate Alfven-wave flux required to heat the upper solar atmosphere is examined.

39762 (N—87-20871, pp vp) **Static current-sheet models of quiescent prominences.** Wu, F.; Low, B.C. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A particular class of theoretical models idealize the prominence to be a discrete flat electric-current sheet suspended vertically in a potential magnetic field. The weight of the prominence is supported by the Lorentz force in the current sheet. These models can be extended to have curved electric-current sheets and to vary three-dimensionally. The equation for force balance is 1 over 4 pi

(del times B) times Bdel p- p9 z=zero. Using Cartesian coordinates we take, for simplicity, a uniform gravity with constant acceleration g in the direction -z. If we are interested not in the detailed internal structure of the prominence, but in the global magnetic configuration around the prominence, we may take prominence plasma to be cold. Consideration is given to how such equilibrium states can be constructed. To simplify the mathematical problem, suppose there is no electric current in the atmosphere except for the discrete currents in the cold prominence sheet. Let us take the plane z =0 to be the base of the atmosphere and restrict our attention to the domain z greater than 0. The task we have is to solve for a magnetic field which is everywhere potential except on some free surface S, subject to suit able to boundary conditions. The surface S is determined by requiring that it possesses a discrete electric current density such that the Lorentz force on it is everywhere vertically upward to balance the weight of the material m(S). Since the magnetic field is potential in the external atmosphere, the latter is decoupled from the magnetic field and its plane parallel hydrostatic pressure and density can be prescribed.

39763 (N—87-20871, pp vp) **Recent observations of the formation of filaments.** Martin, S.F. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Two examples of the formation of small filaments in H alpha are described and illustrated. In both cases, the formation is seen to be the spontaneous appearance of strands of absorbing mass that evolve from no previous structure. The initial development of the filaments appears to consist of the accumulation of these absorptive strands along approximately parallel paths in a channel between large-scale, opposite polarity magnetic fields on either side of the filaments. The strands exhibit continuous changes in shape and degree of absorption which can be due to successive condensations resulting in new strands, mass motions within the strands, and outflow of the mass from the strands. For at least several hours before the formation of both filaments, small-scale fragments of opposite polarity, line-of-sight magnetic flux adjacent to or immediately below the filaments, and at the ends of the filaments, were cancelling. This type of magnetic flux disappearance continued during the development of the filaments and is commonly observed in association with established filaments. Cancellation is interpreted as an important evolutionary change in the magnetic field that can lead to configurations suitable for the formation of filaments.

39764 (N—87-20871, pp vp) **Formation of active region prominences (H alpha filaments).** Rompolt, B.; Bogdan, T. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Analysis of sequential H alpha images of active region prominence formation suggests that simple large-scale photospheric mass-motions may play a key role in the formation of these long, thin, H alpha filaments.

39765 (N—87-20871, pp vp) **Diagnostics and structure.** Vial, J.C. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The structure of prominences and the diagnostic techniques used to evaluate their physical parameters are discussed. These include electron temperature, various densities (n sub p, n sub e, n sub I), ionization degree, velocities, and magnetic field vector. UV and radio measurements have already evidenced the existence of different temperature regions, corresponding to different geometrical locations, e.g., the so called Prominence-Corona (P-C) interface. Velocity measurements are important for considering formation and mass balance of prominences but there are conflicting velocity measurements which have led to the basic question: what structure is actually observed at a given wavelength; what averaging is performed within the projected slit area during the exposure time? In optically thick lines, the question of the formation region of the radiation along the line of sight is also not a trivial one. The same is true for low resolution measurements of the magnetic field. Coupling diagnostics with structure is now a general preoccupation.

39766 (N—87-20871, pp vp) **Temperatures of quiescent prominences measured from hydrogen Paschen and CaII IR lines.** Engvold, O.; Brynildsen, N. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

During 12 to 17 September 1983 a number of prominences were observed with the McMatch solar telescope of National Solar Observatories, using the Fourier transform spectrometer with a InSb detector (Brault 1979). The present study refers to three prominences observed 13 and 14 September. Prominence A: Large quiescent prominence at S28 E90 Prominence B. Stable prominence in weakly enhanced magnetic region at about NO8 E90 Prominence C: Quiescent prominence at N30 E90. Spectra were obtained at a total of 15 different locations in the three prominences in the wavelength range lambda, lambda 7740 to 14,000 Angstroms. The observed differences between T sub exc and T sub kin are hardly significant. Researchers conclude that the two methods for temperature determination when applied to optically thin lines give reasonably consistent results, i.e., the population of the excited levels of hydrogen is collisionally controlled. The well known increase in T and V towards the edge of equiescent prominences (Hirayama 1964) is not corroborated by the present data. One explanation for this could be that prominence A is atypical. The optical thickness of prominence emission lines tends to increase from center to edges as demonstrated by the case of He I lambda 10830 angstroms. If line opacity plays a significant role in earlier center to edge determinations of T and V, a smaller variation would be expected from measurements in optically thin lines, such as in the present case.

39767 (N—87-20871, pp vp) **Dark filaments observed at 8.3mm and 3.1mm wavelength.** Hiel, E.; Ishiguro, M.; Kosugi, T.; Shibasaki, K. (Nagoya Univ., Toyokawa, Japan). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Mapping of the sun was made at 3.1mm (98 GHz) and 8.3mm (36 GHz) wavelengths with a 45m dish radio telescope at the Nobeyama Cosmic Radio Observatory. The depressions associated with large H alpha filaments are derived to be -0.2 at 8.3mm and -0.05 at 3.1mm, which are darker than the values inferred by Raoult et al. (1979)

39768 (N—87-20871, pp vp) **VLA observations of slar filaments at 6 and 20 cm wavelengths.** Kundu, M.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Using the Very Large Array we have observed several solar filaments at 1.5 and 5 GHz. The brightness temperatures of the filaments are 4-5 x 10 K at 20 cm and 1.5-1.6 x 10,000 K at 6 cm. The maximum temperature depressions appear to be associated with H alpha filaments. Comparison with He 10830 angstrons spectroheliogram shows that 20 cm temperature depressions correspond to the regions of reduced intensity in the He 10830 angstrons around filaments, which correspond to coronal cavities. We have studied the temperature and density structure of the transition sheath between the filament and the surrounding corona assuming that the energy radiated away is balanced by the energy conducted from the corona. Researchers find that the observations can be better explained by a model having a pressure gradient in the transition sheath around the filament.

39769 (N—87-20871, pp vp) **Microwave structure of quiescent solar filaments at high resolution.** Gary, D.E. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

High resolution very low altitude maps of a quiescent filament at three frequencies are presented. The spatial resolution (approx. 15″ at 1.45 GHz, approx. 6″ at 4.9 GHz, and approx. 2″ at 15 GHz) is several times better than previously attained. At each frequency, the filament appears as a depression in the quiet Sun background. The depression is measurably wider and longer in extent than the corresponding H alpha filament at 1.45 GHz and 4.9 GHz, indicating that the depression is due in large part to a deficit in coronal density associated with the filament channel. In contrast, the shape of the radio depression at 15 CHz closely matches that of the H alpha filament. In addition, the 15 GHz map shows enhanced emission along both sides of the radio depression. A similar enhancement is seen in an observation of a second filament 4 days later, which suggests that the enhancement is a general feature of filaments. Possible causes of the enhanced emission are explored.

39770 (N—87-20871, pp vp) **Interpretation of the prominence differential emissions measure for 3 geometries.** Schmahl, E.J.; Orrall, F.Q. (Hawaii Univ., Honolulu). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Researchers have used prominence extreme ultraviolet line intensities observed from Skylab to derive the differential emission measure Q(T) in the prominence-corona (PC) interface from 3 x 10,000 to 3 times 1 million K, including the effects of Lyman Continuum absorption. Using lines both shortward and longward of the Lyman limit, researchers have estimated the importance of absorption as function of temperature. The magnitude of the absorption, as well as its rate of increase as a function of temperature, place limits on the thread scales and the character of the interfilar medium. Researchers have calculated models based on three assumed geometries: (1) threads with hot sheaths and cool cores; (2) isothermal threads; and (3) threads with longitudinal temperature gradients along the magnetic field. Comparison of the absorption computed from these models with the observed absorption in prominences shows that none of the geometries is totally satisfactory.

39771 (N—87-20871, pp vp) **Prominence-corona interface and its relationship to the chromosphere-corona transition.** Rabin, D. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The classical model of the chromosphere-corona transition does not account for the observed behavior of the differential emission measure for T approx. less than 100,000 K. Several models have been proposed to resolve this discrepancy in physically different ways. Because the observed differential emission measure at the prominence-corona interface is on average nearly the same as in the chromosphere-corona transition, prominences offer a fresh testing ground for models tailored to the chromosphere-corona transition. The researcher considered three such models and concluded that none extends in a natural way to the environment of prominences. The researcher advanced a simple idea involving thermal conduction both along and across the magnetic field from the corona into cool threads.

39772 (N—87-20871, pp vp) **Thermal stability analysis of the fine structure of solar prominences.** Demoulin, P.; Malherbe, J.M.; Schmieder, B.; Raadu, M.A. (Royal Institute of Technology, Stockholm, Sweden). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The linear thermal stability of a 2D periodic structure (alternatively hot and cold) in a uniform magnetic field is analyzed. The energy equation includes wave heating (assumed proportional to density), radiative cooling and both conduction parallel and orthogonal to magnetic lines. The equilibrium is perturbed at constant gas pressure. With parallel conduction only, it is found to be unstable when the length scale 1// is greater than 45 Mn. In that case, orthogonal conduction becomes important and stabilizes the structure when the length scale is smaller than 5 km. On the other hand, when the length scale is greater than 5 km, the thermal equilibrium is unstable, and the corresponding time scale is about 10,000 s: this result may be compared to observations showing that the lifetime of the fine structure of solar prominences is about one hour; consequently, our computations suggest that the size of the unresolved threads could be of the order of 10 km only.

39773 (N—87-20871, pp vp) **Density and thickness of quiescent prominences.** Hirayama, T. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The electron density was determined for a number of quiescent prominences at various positions from the Stark effect. It was found that the intensity ratio of Mg I emission lines to SrII lines is independent of the observed electron density in the range of ten to the 10.2 power to 10 to the 11.4 power cm-3. This contrasts with Landman's (1984) theoretical expectation that the ratio is proportional to the electron density. From the intensity of Balmer lines and the electron density, it is inferred that the true diameter of a thread in prominence of high electron density may be smaller than 0.2″. The averaged total number density of hydrogen N sub H was found to be 3-6 times 10 to the 11th power cm-3, leading to a total gas pressure P =0.6 dyn cm-2 and a total density of approx. 10 to the minus twelth power g cm-3. Landman's large value of N sub H approx. 6 times 10 to the 12th power and P sub g approx. 6 may have resulted either from the fact that he has treated very bright prominences and/or from the derivation of the high electron density for all prominences he studied.

39774 (N—87-20871, pp vp) **Partial redistribution effects in the formation of hydrogen lines in quiescent prominences.** Heinzel, P.; Gouttebroze, P.; Vial, J.C. (Centre National de la Recherche Scientifique, Verrieres-Le Buisson, France). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Departures from complete frequency redistribution (CRD) in hydrogen lines are investigated for solar prominences. Partial redistribution effects (PRD) are found both in the wings (their already known lowering) and in the central part of the L alpha line; a new feature is evidenced here: the partially coherent scattering in the near wings of the line leads to a double-peaked profile mirroring the incident solar radiation. With a low density model, we obtain a good agreement with OSO 8 observed profiles. On the contrary, the PRD computed L beta profile (lower density, no reversal) departs from the observed one, a result which calls for more progress in terms of non-LTE transfer and modelling.

39775 (N—87-20871, pp vp) **Non-LTE hydrogen-line formation in moving prominences.** Heinzel, P.; Rompolt, B. (National Center for Atmospheric Research, Boulder, CO). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The behavior of hydrogen-line brightness variations, depending on the prominence-velocity changes, were investigated. By solving the non-Local thermodynamic equilibrium (LTE) problem for hydrogen researchers determine quantitatively the effect of Doppler brightening and/or Doppler dimming (DBE, DDE) in the lines of Lyman and Balmer series. It is demonstrated that in low-density prominence plasmas, DBE in H alpha and H beta lines can reach a factor of three for velocities around 160 km/sec, while the L alpha line exhibits typical DDE. L beta brightness variations follow from a combined DBE in the H alpha and DDE in L alpha and L beta itself, providing that all relevant multilevel interlocking processes are taken into account.

39776 (N—87-20871, pp vp) **Vertical motions in the quiescent prominences observed in the He I lambda 10830 angstrom line.** Engvold, O.; Keil, S.L. (Sacramento Peak Observatory, Sunspot, NM). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The observations contain two-dimensional spectral scans of a total of 17 different prominences on the solar disk from the period 3 to 9 May 1981, using the main spectrograph of the solar vacuum telescope at Sacramento Peak. The following conclusions may be drawn from the data: (1) Blue shifts are much more common than red shifts. In many cases more than 90 per cent of the projected prominence area is associated with blue shifts. (2) The darkest prominence regions show the largest blue shift (v less than 3 km s-1). (3) Red shifts are most commonly seen at prominence edges. (4) The general pattern of prominence velocity persists for several hours. On the scale of about 10 arcsec and less, changes are detectable in the course of 2 to 5 minutes. The observed predominance of the blue shifts is largely in agreement with earlier results from H alpha (cf. Martres et al. 1981). It cannot, however, be concluded definitely that the observed shift really represents a net flow of matter. The situation could possibly be analogous to that of the solar transition region where lines such as C IV lambda 1548 angstroms seem to indicate a net inflow, which can hardly be true, at velocities greater than 4 km s(-1) in the quiet Sun (Athay et al. 1983; Gurman and Athay 1983). If the typical structure element of the prominence is sub-resolution, i.e., 2 to 3 arcsec or worse, as in the present case, an apparent net shift could result if the ascending and the decending elements have different temperature and/or pressure. Different lines could then indicate different flow velocities and even opposite directions.

39777 (N—87-20871, pp vp) **Constraints on filament models deduced from dynamical analysis.** Simon, G.; Schmieder, B.; Demoulin, P.; Malherbe, J.M.; Poland, A.I. (Observatoire de Paris-Meudon, France). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The conclusions deduced from simultaneous observations with the Ultra-Violet Spectrometer and Polarimeter (UVSP) on the Solar Maximum Mission satellite, and the Multichannel Subtractive Double Pass (MSPD) spectrographs at Meudon and Pic du Midi observatories are presented. The observations were obtained in 1980 and 1984. All instruments have almost the same field of view and provide intensity and velocity maps at two temperatures. The resolution is approx. 0.5 to 1.5″ for H alpha line and 3″ for C IV. The high resolution and simultaneity of the two types of observations allows a more accurate description of the flows in prominences as functions of temperature and position. The results put some contraints on the models and show that dynamical aspects must be taken into account.

39778 (N—87-20871, pp vp) **C IV Doppler shifts observed in active region filaments.** Klimchuk, J.A. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The Doppler shift properties of 21 active region filaments were studied using C IV Dopplergram data. Most are associated with corridors of weak magnetic field that separate opposite polarity strong fields seen in photospheric magnetograms. A majority of the filaments are relatively blue shifted, although several lie very close to the dividing lines between blue and red shift. Only one filament in the samples is clearly red shifted. A new calibration procedure for Dopplergrams indicates that sizable zero point offsets are often required. The center-to-limb behavior of the resulting absolute Doppler shifts suggests that filament flows are usually quite small. It is possible that they vanish.

39779 (N—87-20871, pp vp) **Existence of oscillations in solar filaments observed in H alpha and C IV lines.** Schmieder, B.; Malherbe, J.M.; Mein, P.; Tandberg-Hanssen, E. (Observatoire de Paris-Meudon, France). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Time sequence observations of filaments in both the H alpha line and the 1548 A C IV line were analyzed with the Fourier transform technique in the frequency range (1 - 10 mHz). No oscillation is detected in filaments except at the footpoints where a steady velocity gradient is large. The energy is probably due to convective motions rather than pressure oscillations.

39780 (N—87-20871, pp vp) **Measurements of magnetic fields in solar prominences.** Deglinnocenti, E.L. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Magnetic fields can be measured in solar prominences by means of two different basic mechanisms that are responsible for the introduction (or the reduction) of a given amount of polarization in spectral lines: these are the Zeeman effect and the Hanle effect. Through the splitting of the magnetic components of a spectral line, the Zeeman effect is capable of introducing a certain amount of circular polarization across the line profile. The Hanle effect consist of a modification of the linear polarization that is induced in spectral lines by the anisotropic illumination of the prominence plasma by the photospheric radiation field. These two effects are briefly discussed.

39781 (N—87-20871, pp vp) **Magnetic field vector and electron density diagnostics from linear polarization measurements in 14 solar prominences.** Bommier, V. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The Hanle effect is the modification of the linear polarization parameters of a spectral line due to the effect of the magnetic field. It has been successfully applied to the magnetic field vector diagnostic in solar prominences. The magnetic field vector is determined by comparing the measured polarization to the polarization computed, taking into account all the polarizing and depolarizing processes in line formation and the depolarizing effect of the magnetic field. The method was applied to simultaneous polarization measurements in the helium D3 line and in the hydrogen beta line in 14 prominences. Four polarization parameters are measured, which lead to the determination of the three coordinates of the magnetic field vector and the electron density, owing to the sensitivity of the hydrogen beta line to the non-negligible effect of depolarizing collisions with electrons and protons of the medium. A mean value of 1.3 x 10 to the 10th power cu. cm. is derived in 14 prominences.

39782 (N—87-20871, pp vp) **Filament disappearances.** Wagner, W.J. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The phenomenon of the sudden filament disappearance (Disparition Brusque) is a familiar one to observers at H alpha telescopes. Nevertheless, the importance in Disparition Brusques (DB) continues to grow for several reasons which are cited in the discussion. It is reported that there seems to be more interest on building and maintain filaments than in destroying them. As a consequence, this sub-group is smaller than most of the others. All the same, progress in this area of filament disapperences seems steady and assured. The importance and interest in DBs is discussed and future directions are indicated.

39783 (N—87-20871, pp vp) **Heating of filaments as a disappearance process.** Mouradian, Z.; Martres, M.J.; Soru-escaut, I. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The sudden disappearance of filaments, commonly called Disparition Brusque (DB) is of two types: (1) the well known ejection of cool prominence material in the corona, i.e., a dynamic process (BDd) and (2) the heating of the prominence plasma. When the hydrogen of the filament becomes ionised, then the filament start to be visible in EUV lines keeping the same shape and position as the cool one. This process which is a thermic disapperence was named DB thermic (DBt). Successive disappearances and condensations of a quiescent filament from 13 to 17 of June 1973 was studied. This observation was provided by two instruments on Skylab ATM satellite. These observations of disappearances and condensations are discussed.

39784 (N—87-20871, pp vp) **Thermal durability of solar prominences, or how to evaporate a prominence.** Malherbe, J.M.; Forbes, T.G. (New Hampshire Univ., Durham). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The thermal disappearance of solar prominences under strong perturbations due to wave heating, Ohmic heating, viscous heating or conduction was investigated. Specifically, how large a thermal perturbation is needed to destroy a stable thermal equilibrium was calculated. It was found that the prominence plasma appears to be thermally very rugged. Its cold equilibrium may most likely be destroyed by either strong magnetic heating or conduction in a range of parameters which is relevant to flares.

39785 (N—87-20871, pp vp) **Filament eruption connected to protospheric activity.** Simon, G.; Gesztelyi, L.; Schmieder, B.; Mein, N. (Hungarian Academy of Sciences, Debrecen). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Two cases of activation of filaments that occured in regions of intense magnetic activity was studied. The simultaneous observations from Debrecen Observatory (white light and H alpha filtergram), and from Meudon Observatory (magnetogram, MSDP dopplergram and intensity maps in H alpha) gave a complementary set of data from which can be produced evidence of the influence of the photospheric magnetic field on the destabilization process of the filaments. On June 22, 1980, the eruption of the filament is associated with the motion of pores, which are manifestations of emerging flux knots. On September 3, 1980, the twisting motions in the filament are associated to the birth of a pore in its neighborhood. These observations are discussed.

39786 (N—87-20871, pp vp) **Magnetic field re-arrangement after prominence eruption.** Kopp, R.A.; Poletto, G. (Florence Univ., Italy). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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It has long been known that magnetic reconnection plays a fundamental role in a variety of solar events. Although mainly invoked in flare problems, large scale loops interconnecting active regions, evolving coronal hole boundaries, the solar magnetic cycle itself, provide different evidence of phenomena which involve magnetic reconnection. A further example might be given by the magnetic field rearrangement which occurs after the eruption of a prominence. Since most often a prominence reforms after its disappearance and may be observed at about the same position it occupied before erupting, the magnetic field has to undergo a temporary disruption of relax back, via reconnection, to a configuration similar to the previous one. The above sequence of events is best observable in the case of two ribbon (2-R) flares but most probably is associated with all filament eruptions. Even if the explanation of the magnetic field rearrangement after 2-R flares in terms of reconnection is generally accepted, the lack of a 3-dimensional model capable of describing the field reconfiguration, has prevented, up to now, a thorough analysis of its topology as traced by H alpha/x ray loops. A numerical technique is presented which enables one to predict and visualize the reconnected configuration, at any time, and therefore allows one to make a significant comparison of observations and model predictions throughout the whole process.

39787 (N—87-20871, pp vp) **Dynamic model of filament eruptions and two ribbon flares.** Kuin, N.M.; Martens, P.C.H. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Two basically different models for the filament equilibrium by Kippenhahn and Schluter (1957) and Kuperus and Raadu (1974) have appeared in the literature. A further analyses by van Tend and Kuperus (1978) added the force due to the horizontal component of the background field to the Kuperus and Raadu model. In order to obtain a better model which actually describes these phenomena, the evolution of the filament has to be considered in detail. A first attempt was recently presented by Kaastra. Kaastra did not formulate the precise energy balance equations for the problem, as is done in the present work. In the present model not only the force balance, but also the energy balance of the filament is taken into account. Thus a fully closed system of equations is obtained, that describes the evolution of the filament, first in force equilibrium during the current build-up phase, then in the non-equilibrium phase before the eruption, and the eruption itself. A neutral point appears above the photospheric surface in the non-equilibrium phase, but long before the eruption. It was found that although the filament itself may be in non-equilibrium, the evolution may still be slow up to the height where the eruption takes place. The eruption of the filament itself causes a large induced electric field at the neutral point which leads to the observed flare phenomena.

39788 (N—87-20871, pp vp) **Large scale structure of the corona.** Kundu, M.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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This is an introduction to this section of the proceedings. In this section is a brief description of some radio results obtained with meter-decameter radioheliograph. An optical study based upon synoptic data of polarized brightness (pB), H alpha line filtergrams and large scale B-fields is presented. This is followed by two papers on the interpretation of coronal mass ejection (CME) and modeling of three dimensional coronas.

39789 (N—87-20871, pp vp) **Large scale structure of the sun's radio corona.** Kundu, M.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Results of studies of large scale structures of the corona at long radio wavelengths are presented, using data obtained with the multifrequency radioheliograph of the Clark Lake Radio Observatory. It is shown that features corresponding to coronal streamers and coronal holes are readily apparent in the Clark Lake maps.

39790 (N—87-20871, pp vp) **Synoptic study of the corona at meter wavelength.** Lantos, P.; Alissandrakis, C.E. (Athens Univ., Greece). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The Mark III Nancay Radioheliograph is used to observe the Sun at 169 MHz with a time resolution of 25 East-West and North-South images per second. When the brightness distribution of the Sun is stable during the eight hours of daily observation, a

two dimensional map can be produced using the technique of earth rotation synthesis. The best images are obtained during the period April to August, when the declination of the Sun is high to give a good coverage in the uv plane and a reasonable North-South resolution. The spatial resolution is 1.5' East-West and in summer, 3.5' North-South. The maps are calibrated using Cygnus A as a reference. Examples of the maps are given and discussed.

39791 (N—87-20871, pp vp) **White light corona and photospheric magnetic fields.** Mccabe, M.K. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Some results are presented from a continuing investigation of the coronal structure vs. the photospheric magnetic field relationship. Two approaches to the problem are considered. First, the individual coronal features recorded at each limb were located on a chart of the magnetic field measured with low spatial resolution, depicting the large scale or global field configuration. Second, the characteristics of neutral line segments, defined by the presence of H alpha line filament, with no associated coronal structure were investigated. Preliminary results are discussed.

39792 (N—87-20871, pp vp) **Quasistatic evolution of magnetostatic coronal structures.** Wolfson, R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Four separate but related studies of coronal magnetostatic equilibria under a variety of boundary conditions and distributions of coronal current are reviewed. Physically, all four studies assume an axisymmetric corona whose radial magnetic field at the coronal base is dipolar. Electric currents in the model coronas are assumed to flow in the azimuthal direction, giving rise to Lorentz forces that must be balanced by pressure gradients and gravity. Mathematically, such coronas are described by the equation of magnetostatic force balance and Ampere's law. Although highly idealized, the axisymmetric magnetostatic models described provide insights into the behavior of a variety of coronal structures. The models show how more realistic current sheet boundary conditions and coronal density variations may be modeled.

39793 (N—87-20871, pp vp) **Three-dimensional magnetostatic models of the large-scale corona.** Bogdan, T.J.; Low, B.C. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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A special class of magnetostatic equilibria is described, which are mathematically simple and yet sufficiently versatile so as to fit any arbitrary normal magnetic flux prescribed at the photosphere. With these solutions, the corona can be modeled with precisely the same mathematically simple procedure as has previously been done with potential fields. The magnetostatic model predicts, in addition to the coronal magnetic field, the three dimensional coronal density which can be compared with coronagraph observations.

39794 (N—87-20871, pp vp) **Coronal diagnostics.** Lang, K.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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This is an introduction to this part of the proceedings and an overview of coronal diagnostics. The current understanding of coronal loops is summarized. Included are observations from ground-based radio telescopes and from X ray telescopes lofted above the atmosphere, as well as theoretical interpretations of these observations. Also included in these introductory remarks is a discussion of the three dimensional structure of coronal loops. Alternative radiation mechanisms are then described within the context of both the radio and X ray emission. Various methods of determining the strength and structure of the coronal magnetic field are then described, followed by the coronae of nearby stars and future prospects for radio diagnostic of coronal loops.

39795 (N—87-20871, pp vp) **Three dimensional structures of solar active regions.** Kundu, M.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Three dimensional structure of an active region is determined from observations with the Very Large Array (VLA) at 2, 6, and 20 cm. This region exhibits a single magnetic loop of length approx. 10 to the 10th power cm. The 2 cm radiation is mostly thermal bremsstrahlung and originates from the footpoints of the loop. The 6 and 20 cm radiation is dominated by the low harmonic gyroresonance radiation and originates from the upper portion of the legs or the top of the loop. The loop broadens toward the apex. The top of the loop is not found to be the hottest point, but two temperature maxima on either side of the loop apex are observed, which is consistent with the model proposed for long loops. From 2 and 6 cm observations it can be concluded that the electron density and temperature cannot be uniform in a plane perpendicular to the axis of the loop; the density should decrease away from the axis of the loop.

39796 (N—87-20871, pp vp) **High-spatial-resolution microwave and related observations as diagnostics of coronal loops.** Holman, G.D. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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High spatial resolution microwave observations of coronal loops, together with theoretical models for the loop emission, can provide detailed information about the temperature, density, and magnetic field within the loop, as well as the environment around the loop. The capability for studying magnetic fields is particularly important, since there is no comparable method for obtaining direct information about coronal magnetic fields. Knowledge of the magnetic field strength and structure in coronal loops is important for understanding both coronal heating and flares. With arc-second-resolution microwave observations from the Very Large Array (VLA), supplemental high-spectral-resolution microwave data from a facility such as the Owens Valley frequency-agile interferometer, and the ability to obtain second-of-arc resolution EUV aor soft X ray images, the capability already exists for obtaining much more detailed information about coronal plasma and magnetic structures than is presently available. This capability is discussed.

39797 (N—87-20871, pp vp) **Theoretical models of free-free microwave emission from solar magnetic loops.** Brosius, J.W.; Holman, G.D. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The free-free microwave emission is calculated from a series of model magnetic loops. The loops are surrounded by a cooler external plasma, as required by recent simultaneous x-ray and microwave observations, and a narrow transition zone separating the loops from the external plasma. To be consistent with the observational results, upper limits on the density and temperature scale lengths in the transition zone are found to be 360 km and 250 km, respectively. The models which best produce agreement with x-ray and microwave observations also yielded emission measure curves which agree well with observational emission measure curves for solar active regions.

39798 (N—87-20871, pp vp) **Coronal plasmas on the sun and nearby stars.** Lang, K.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The current understanding of the quiescent, or non-flaring, microwave emission from solar active regions is summarized. The

thermal radiation mechanisms that account for most of the quiescent emission is reviewed, while it is also pointed out that current-amplified magnetic fields or non-thermal radiation may be required in some instances. The 20 cm radiation of coronal loops and the thermal cyclotron lines that accurately specify their magnetic field strength are discussed. The 20 cm and x-ray emission of the coronal plasma are then compared. The coronae of nearby stars is next discussed, where coherent radiation processes seem to prevail. Some thoughts toward directions for future exploration are given.

39799 (N—87-20871, pp vp) **Measurement of coronal fields using spatially resolved microwave spectroscopy.** Hurford, G.J.; Gary, D.E. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The potential implications of observations which combine both high spatial and high spectral resolution are considered. In particular, interest is on the ability to measure the magnetic field at the base of the corona on a point by point basis, as in a true magnetograph. Model calculations are presented of the microwave brightness temperature spectrum along specific lines of sight near a sunspot.

39800 (N—87-20871, pp vp) **Guided MHD waves as a coronal diagnostic tool.** Roberts, B. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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A description is provided of how fast magnetoacoustic waves are ducted along regions of low Alfven velocity (high density) in the corona, exhibiting a distinctive wave signature which may be used as a diagnostic probe of in situ coronal conditions (magnetic field strength, density inhomogeneity, etc.). Some observational knowledge of the start time of the impulsive wave source, possibly a flare, the start and end times of the generated wave event, and the frequency of the pulsations in that event permits a seismological deduction of the physical properties of the coronal medium in which the wave propagated. With good observations the theory offers a new means of probing the coronal atmosphere.

39801 (N—87-20871, pp vp) **Small-scale coronal structure, part 3.** Webb, D.F. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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Recent observations and models pertaining specifically to solar coronal bright points (BPs) and generally to small-scale coronal structure are reviewed. Two questions were addressed: What is the degree of correspondence among various alleged signatures of BPs at different levels of atmosphere and what can PBs tell about the emerging flux spectrum of the sun?

39802 (N—87-20871, pp vp) **Simultaneous observations of changes in coronal bright point emission at the 20 cm radio and He Lambda 10830 wavelengths.** Habbal, S.R.; Harvey, K.L. (Solar Physics Research Corp., Tucson, AZ). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Preliminary results of observations of solar coronal bright points acquired simultaneously from ground based observatories at the radio wavelength of 20 cm and in the He I wavelength 10830 line on September 8, 1985, are reported. The impetus for obtaining simultaneous radio and optical data is to identify correlations, if any, in changes of the low transition-coronal signatures of bright points with the evolution of the magnetic field, and to distinguish between intermittent heating and changes in the magnetic field topology. Although simultaneous observations of H alpha emission and the photospheric magnetic field at Big Bear were also made, as well as radio observations from Owen Valley Radio Interferometer and Solar Maximum Mission (SSM) (O VIII line), only the comparison between He 10830 and the Very Large Array (VLA) radio data are presented.

39803 (N—87-20871, pp vp) **VLA observations of coronal bright points at 6 and 20 cm wavelengths.** Kundu, M.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Prior to and during the Spacelab-2 operation, observations were made at 6 and 20 cm of solar coronal bright points, using the Very Large Array (VLA) in the C-configuration. The ultraviolet coverage ranged from 200 to 18,000 wavelengths. The maps were convolved with beams of 18 x 18 inches at 20 km and 4 x 4 inches at 6 cm. Only the preliminary results from July 15 and July 31, 1985 observations.

39804 (N—87-20871, pp vp) **Compact, variable, moving sources observed on the sun at 2 centimeters wavelength.** Lang, K.R.; Willson, R.F. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The Very Large Array (VLA) was used to observe the active region AT 4508 in the C-configuration between 1530 and 2330 UT on June 4, 1984. The position of this region was N06 E57 at 1300 UT on this day. Followup observations were made between 1500 and 2300 UT on January 17, 1986 in the D-configuration. Observations were compared with Mt. Wilson magnetograms. Results are discussed.

39805 (N—87-20871, pp vp) **Association of chromospheric and coronal phenomena with the evolution of the quiet sun magnetic fields.** Harvey, K.L.; Tang, F.; Gaizauskas, V. (California Institute of Technology, Pasadena; National Research Council of Canada, Ottawa, Ontario). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Using daily full-disk magnetograms and He I 10830 spectroheliograms to study the count and surface distribution of ephemeral regions over the solar cycle, Harvey (1985) concluded that the small dark structures seen in 10830, thought to correspond to x-ray bright points, were more often associated with magnetic bipoles that appeared to result from an encounter of already existing opposite polarity magentic flux than with emerging small magnetic bipoles (ephemeral regions). Such encounters would be more likely to occur in areas of mixed polarity. The fractional area of the sun covered by mixed polarity fields varies anti-correlated with the solar cycle leading to a possible explanation for the 180 degrees out of phase solar cycle variation of x-ray bright points. To establish the validity of this suggestion, a detailed study of time-sequence magnetic field, He I wavelength 10830, Ha, C IV, and Si II observations of selected areas of the quiet sun was initiated about 2 years ago. The preliminary results of this study are reported.

39806 (N—87-20871, pp vp) **Magnetogram and soft X-ray comparisons of XBP and ER.** Golub, L.; Harvey, K.L.; Webb, D.F. (Solar Physics Research Corp., Tucson, AZ; Air Force Geophysics Lab., Hanscom AFB, MA). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The potential importance of the smallest emerging flux regions on the sun was discussed in numerous publications. The association between the objects seen in ground-based data, such as high resolution magnetrons or H alpha and soft x-ray data has produced results which are often contradictory. In the hope of resolving the present impasse, as much simultaneous soft x-ray and magnetogram data as possible were assembled in order to clarify the situation. It was found that separation of magnetic features into chance encounters and emerging flux makes some difference in overlapp with x-ray bright points (XBPs), although the effect is not overwhelming.

The difference in solar cycle dependence between XBP and ephemeral regions is not explainable in terms of the results.

39807 (N—87-20871, pp vp) **Small-scale eruptive filaments on the quiet sun.** Hermans, L.M.; Martin, S.F. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A study of a little known class of eruptive events on the quiet sun was conducted. All of 61 small-scale eruptive filamentary structures were identified in a systematic survey of 32 days of H alpha time-lapse films of the quiet sun acquired at Big Bear Solar Observatory. When fully developed, these structures have an average length of 15 arc seconds before eruption. They appear to be the small-scale analog of large-scale eruptive filaments observed against the disk. At the observed rate of 1.9 small-scale eruptive features per field of view per average 7.0 hour day, the rate of occurence of these events on the sun were estimated to be greater than 600 per 24 hour day.. The average duration of the eruptive phase was 26 minutes while the average lifetime from formation through eruption was 70 minutes. A majority of the small-scale filamentary sturctures were spatially related to cancelling magnetic features in line-of-sight photospheric magnetograms. Similar to large-scale filaments, the small-scale filamentary structures sometimes divided opposite polarity cancelling fragments but often had one or both ends terminating at a cancellation site. Their high numbers appear to reflect the much greater flux on the quiet sun. From their characteristics, evolution, and relationship to photospheric magnetic flux, it was concluded that the structures described are small-scale eruptive filaments and are a subset of all filaments.

39808 (N—87-20871, pp vp) **Observations of the Ca II K line in Hel0830A dark points on August 3, 1985.** Holt, R.D.; Park, A.H.; Thompson, J.C.; Mullan, D.M. (Delaware Univ., Newark). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Spectroheliograms taken in the light of He I 10830 A at the National Solar Observatory Vacuum Telescope on Kitt Peak were used to identify coronal holes and bright points (BPs). Target points were identified, coordinates calculated, and spectra recorded. For each spectrum, the difference in wavelength between the Ca II K minimum and the FeI reference line was calculated. It was noteworthy that the overall effect is a blueshift. It should be noted that if material of chromospheric density moves outward at this velocity, it could supply the mass flux of the solar wind if this chromospheric flow was concentrated in a few dozen sources, each of a diameter of a few arc seconds.

39809 (N—87-20871, pp vp) **Magnetic location of C IV events in the quiet network.** Porter, J.G.; Reichmann, E.J.; Moore, R.L.; Harvey, K.L. (Solar Physics Research Corp., Tucson, AZ). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Ultraviolet Spectrograph and Polarimeter (UVSP) observations of C IV intensity in the quiet sun were examined and compared to magnetograms and He I 10830 A spectroheliograms from Kitt Peak National Laboratory. The observations were made between 3 and 9 April, 1985. Spatially rastered UVSP intensity measurements were obtained at 11 wavelength positions in the 1548 A line of C IV. It was concluded that the stochastic process whereby convective shuffling of loop footprints leads to many topically dissipative events in active regions and the larger bipoles treated here continues to operate in regions of fewer, weaker flux loops, but the resulting events above threshold are less frequent.

39810 (N—87-20871, pp vp) **Numerical study of the thermal stability of low-lying coronal loops.** Klimchuk, J.A.; Antiochos, S.K.; Mariska, J.T. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The nonlinear evolution of loops that are subjected to a variety of small but finite perturbations was studied. Only the low-lying loops are considered. The analysis was performed numerically using a one-dimensional hydrodynamical model developed at the Naval Research Laboratory. The computer codes solve the time-dependent equations for mass, momentum, and energy transport. The primary interest is the active region filaments, hence a geometry appropriate to those structures, was considered. The static solutions were subjected to a moderate sized perturbation and allowed to evolve. The results suggest that both hot and cool loops of the geometry considered are thermally stable against amplitude perturbations of all kinds.

39811 (N—87-20871, pp vp) **Small-scale structures and the density irregularity of the inner corona.** Orrall, F.Q.; Rottman, G.J. (Colorado Univ., Boulder). Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The observational evidence is considered that the electron density irregularity factor is much greater than unity in the inner corona, in particular, evidence derived from the photometric comparison of the K-corona emission p Beta with the EUV emission from coronal ions. A simple mathematical model was developed for the irregularity having a minimum number of parameters. This model was used to explore some implications of the observations and to show that well-known resolved structures such as polar plumes and coronal loops as presently understood cannot alone explain the irregularity.

39812 (N—87-20871, pp vp) **Phlegethon flow: a proposed origin for spicules and coronal heating.** Schatten, K.H.; Mayr, H.G. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A model was develped for the mass, energy, and magnetic field transport into the corona. The focus is on the flow below the photosphere which allows the energy to pass into, and be dissipated within, the solar atmosphere. The high flow velocities observed in spicules are explained. A treatment following the work of Bailyn, et al., (1985) is examined. It was concluded that within the framework of the model, energy may dissipate at a temperature comparable to the temperature where the waves originated, allowing for an equipartition solution of atmospheric flow, departing the sun at velocities approaching the maximum Alfven speed.

39813 (N—87-20871, pp vp) **Energy conversion in the coronal plasma.** Martens, P.C.H. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Solar and stellar x-ray emission are the observed waste products of the interplay between magnetic fields and the motion of stellar plasma. Theoretical understanding of the process of coronal heating is of utmost importance, since the high temperature is what defines the corona in the first place. Most of the research described deals with the aspects of the several rivalling theories for coronal heating. The rest of the papers deal with processes of energy conversion related to flares.

39814 (N—87-20871, pp vp) **Topological constraints and the existence of force-free fields.** Antiochos, S.K. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

A fundamental problem in plasma theory is the question of the existence of MHD equilibria. The issue of topological constraints is of crucial importance for the problem of the existence of equilibria. Heuristic methods are used to discuss the coronal wrap-

ping pattern. It is concluded that for a given set of footpoint positions the wrapping pattern in the corona is completely fixed. The topological constraints are included in the boundary conditions on the Euler potentials and impost no additional restrictions on possible equilibria. Although this does not prove that equilibria always exist, it does show that the force-free problem is not overdetermined and that existence of equilibria is still an open question.

39815 (N—87-20871, pp vp) **Topological description of coronal magnetic fields.** Berger, M.A. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

Determining the structure and behavior of solar coronal magnetic fields is a central problem in solar physics. At the photosphere, the field is believed to be strongly localized into discrete flux tubes. After providing a rigorous definition of field topology, how the topology of a finite collection of flux tubes may be classified is discussed.

39816 (N—87-20871, pp vp) **Coordinate free description of magnetohydrostatic equilibria.** Martens, P.C.H. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The question what geometrical restrictions are imposed on static magnetic fields by the magnetohydrostatic (MHS) equation is addressed. The general mathematical problem is therefore to determine the solutions of the MHS equations in the corona subject to an arbitrary normal component of the magnetic field at the boundary and arbitrary connectivity. What constraints the MHS equations impose on the geometry of the solutions, expressed in metric tensors, will be determined.

39817 (N—87-20871, pp vp) **Cascade model of coronal heating.** Vanballegooijen, A.A. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

It is suggested that the quasi-static evolution of coronal magnetic structures is characterized by a cascade of magnetic energy to smaller length scales. This cascade process takes place on a time scale t sub b determined entirely by the photospheric motions. The Ohmic heating rate E sub H in the statistically stationary state was estimated using observational data on the diffusivity of photospheric motions; E sub H turned out to be too small by a factor of 40 when compared with observed coronal energy losses. However, given the fact that the theoretical estimate is based on a rather uncertain extrapolation to the diffusive regime, current heating cannot be ruled out as a viable mechanism of coronal heating.

39818 (N—87-20871, pp vp) **Heating of the solar corona by the resonant absorption of Alfven waves.** Davila, J.M. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

An improved method for calculating the resonance absorption heating rate is discussed and the results are compared with observations in the solar corona. The primary conclusion to be drawn from these calculations is that to the level of the approximation adopted, the observations of the heating rate and nonthermal line broadening in the solar corona are consistent with heating by the resonance absorption mechanism.

39819 (N—87-20871, pp vp) **Magnetic helicity as a constraint on coronal dissipation.** Choudhuri, A.R. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

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The Taylor hypothesis has provided a model for the relaxed magnetic configurations of not only laboratory plasmas, but also of astrophysical plasmas. However, energy dissipation is possible only for systems which depart from a strict Taylor state, and hence a parameter describing that departure must be introduced, when the Taylor hypothesis is used to estimate the dissipation. An application of the Taylor hypothesis to the problem of coronal heating provides an insight into this difficult problem. When particular sorts of footpoint motions put energy and helicity in the corona, the conservation of helicity puts a constraint on how much of the energy can be dissipated. However, on considering a random distribution of footpoint motions, this constraint gets washed away, and the Taylor hypothesis is probably not going to play any significant role in the actual calculation of relevant physical quantities in the coronal heating problem.

39820 (N—87-20871, pp vp) **Stability of coronal and prominence magnetic fields.** Hood, A.W. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The significance of the localized instabilities is not yet fully understood. The nonlinear coupling of these modes may give rise to an explosive instability, with the modes coupling to longer wavelengths. On the other hand, if the modes saturate early, than the main effect of the instability may be an enhancement of transport coefficients. Nonetheless, the equation provides a simple test for the stability of cylindrical magnetic fields.

39821 (N—87-20871, pp vp) **Resistive ballooning modes in line-tied coronal arcades.** Velli, M. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The equations describing the linear evolution of resistive ballooning modes are obtained by using a modified WKB expansion in the short perpendicular wavelength, while variations of the perturbations along the field are described by a slowly varying amplitude, on which the tying boundary conditions are imposed. In general, given an equilibrium, there are certain ranges of magnetic surfaces for which the system predicts instability even without dissipation. The main conclusion is that within the resistive MHD approximation cylindrically symmetric arcades with pressure falling with radius are unstable to resistive localized modes; the growth rates, close to ideal marginal stability, are large, so that it would appear that energy could be released during 10 to 100 Alfven times. The wavelength of the modes is expected to be limited by the ion gyroradius, when stabilizing drift effects must be taken into account. The nonlinear evolution of resistive ballooning modes should be studied to assess their overall relevance to the violent and rapidly evolving phenomena observed on the sun.

39822 (N—87-20871, pp vp) **Effects of flows on viscous and resistive MHD stability.** Einaudi, G. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

In many solar applications the viscosity appears to be more important than resistivity. In order to discuss the instabilities in solar conditions, an idealized configuration is considered in which the plasma is flowing in the z-direction along the magnetic field B sub 0 with a velocity V sub 0. As far as the velocity is concerned two different velocity profiles, with different hydrodynmaic stability properties are discussed. The results are summarized.

39823 (N—87-20871, pp vp) **Large-scale electric fields resulting from magnetic reconnection in the corona.** Kopp, R.A.; Poletto, G. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The method of Forbes and Priest (2-D model) is applied to the large two-ribbon flare of July 29, 1973, for which both detailed H observations and magnetic data are available. For this flare the

ribbons were long, nearly straight, and parallel to each other, and the 2-D model for the coronal field geometry may be adequate. The temporal profile E(t) is calculated and indicates that reconnection sets in at the beginning of the decay phase. From this time the electric field grows rapidly to a maximum value of about 2 V/cm within just a few minutes. Thereafter it decreases monotonically with time.

39824 (N—87-20871, pp vp) **Dynamic evolution of coronal magnetic fields.** Steinolfson, R.S. Dec 1986. NTIS, PC A19/MF A01. (NASA-CP—2442; REPT—86BO536; NAS—1.55:2442; CONF-8504308—).

From Coronal and prominence plasmas conference; Greenbelt, MD, USA (9 Apr 1985).

The response of coronal magnetic fields to photospheric motion is investigated using a time-dependent, two-dimensional MHD simulation. Starting with an initially uniform field, a circular section of the loop base is slowly rotated to represent the photospheric motion. The field lines at the base move with this flow in a manner consistent with the generated electric fields. The subsequent evolution of the field and flow can be characterized as passing through several distinct configurations. In the earliest phase the kinetic energy is negligible, and the current and field are parallel throughout most of the cylinder. This is followed by a period in which the field rotation increases, the axial field at and near the axis increases, and the axial field decreases in two cylindrical regions away from the axis. When the field in an appreciable portion of the cylinder has undergone one complete rotation, a rapid change in field configuration occurs with a large portion of the field making several rotations at large radii and a corresponding large reduction in the axial field.

39825 (N—87-21785, pp vp) **Rapid fluctuations in solar flares.** Sturrock, P.A. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Study of rapid fluctuations in the emission of radiation from solar flares provides a promising approach for probing the magneto-plasma structure and plasma processes that are responsible for a flare. It is proposed that elementary flare bursts in x ray and microwave emission may be attributed to fine structure of the coronal magnetic field, related to the aggregation of photospheric magnetic field into magnetic knots. Fluctuations that occur on a subsecond time-scale may be due to magnetic islands that develop in current sheets during magnetic reconnection. The impulsive phase may sometimes represent the superposition of a large number of the elementary energy-release processes responsible for elementary flare bursts. If so, the challenge of trying to explain the properties of the impulsive phase in terms of the properties of the elementary processes must be faced. Magnetic field configurations that might produce solar flares are divided into a number of categories, depending on: whether or not there is a filament; whether there is no current sheet, a closed current sheet, or an open current sheet; and whether the filament erupts into the corona, or is ejected completely from the Sun's atmosphere. Analysis of the properties of these possible configurations is compared with different types of flares, and to Bai's subdivision of gamma-ray/proton events.

39826 (N—87-21785, pp vp) **Sub-second variations of high energy (300 keV) hard x-ray emission from solar flares.** Bai, T. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Subsecond variations of hard x ray emission from solar flares were first observed with a balloon-borne detector. With the launch of the Solar Maximum Mission (SMM), it is now well known that subsecond variations of hard x ray emission occur quite frequently. Such rapid variations give constraints on the modeling of electron energization. Such rapid variations reported until now, however, were observed at relatively low energies. Fast mode data obtained by the Hard x ray Burst Spectrometer (HXRBS) has time resolution of approximately 1 ms but has no energy resolution. Therefore, rapid fluctuations observed in the fast-mode HXRBS data are dominated by the low energy hard x rays. It is of interest to know whether rapid fluctuations are observed in high-energy x rays. The highest energy band at which subsecond variations were observed is 223 to 1057 keV. Subsecond variations observed with HXRBS at energies greater than 300 keV are reported, and the implications discussed.

39827 (N—87-21785, pp vp) **Interpretation of rapid rises in hard x rays and microwaves with the thermal conduction front model.** Batchelor, D.A. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Impulsive hard x ray and microwave bursts with rise times from 0.1 to 10 seconds are discussed. Source areas calculated by the method of Crannell, et al., (1978) were compared with source areas determined from Hinotori and the Hard x ray Imaging Spectrometer (HXIS) images. The agreement strongly suggests that the method is valid. If the thermal conduction front model for the hard x ray and microwave source is adopted, then the method enables derivation of area, density, magnetic field, and rise time from hard x ray and microwave spectral observations. This approach was used to derive these parameters for several rapid impulsive rises in the flares of July 1, 1980, and May 21, 1984. It is shown that the model provides a consistent interpretation of the observations of these impulsive increases. Indeed, the model provides a way to calculate rise times from spectra alone (to within a factor of about three) over more than two orders of magnitude.

39828 (N—87-21785, pp vp) **Impulsive phase solar flare X-ray polarimetry.** Chanan, G.; Emslie, A.G.; Novick, R. (Alabama Univ., Huntsville; Columbia Univ., NY). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The pioneering observational work in solar flare x ray polarimetry was done in a series of satellite experiments by Tindo and his collaborators in the Soviet Union; initial results showed high levels of polarization in x ray flares (up to 40%), although of rather low statistical significance, and these were generally interpreted as evidence for strong beaming of suprathermal electrons in the flare energy release process. However, the results of the polarimeter flown by the Columbia Astrophysics Laboratory as part of the STS-3 payload on the Space Shuttle by contrast showed very low levels of polarization. The largest value (observed during the impulsive phase of a single event) was 3.4% + or - 2.2%. At the same time but independent of the observational work, Leach and Petrosian (1983) showed that the high levels of polarization in the Tindo results were difficult to understand theoretically, since the electron beam is isotropized on an energy loss timescale. A subsequent comparison by Leach, Emslie, and Petrosian (1985) of the impulsive phase STS-3 result and the above theoretical treatment shows that the former is consistent with several current models and that a factor of approximately 3 improvement in sensitivity is needed to distinguish properly among the possibilities.

39829 (N—87-21785, pp vp) **Persistent time intervals between features in solar flare hard X-ray emission.** Desai, U.D.; Kouveliotou, C.; Barat, C.; Hurley, K.; Niel, M.; Talon, R.; Vedrenne, G. (Centre d'Etude Spatiale des Rayonnements, Toulouse, France). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Several solar hard x ray events (greater than 100 keV) were observed simultaneously with identical instruments on the Venera 11, 12, 13, 14, and Prognoz spacecraft. High time resolution (= 2 ms) data were stored in memory when a trigger occurred. The observations of modulation are presented with a period of 1.6 s for the event on December 3, 1978. Evidence is also presented for fast time fluctuations from an event on November 6, 1979, observed from Venera 12 and another on September 6, 1981, observed from the Solar Maximum Mission. Power spectrum analysis, epoch folding, and Monte Carlo simulation were used to evaluate the statistical significance of persistent time delays between features. The re-

sults are discussed in light of the MHD model proposed by Zaitsev and Stepanov.

39830 (N—87-21785, pp vp) **Evidence for beamed electrons in a limb x ray flare observed by hard x-ray imaging spectrometer (HXIS).** Haug, E.; Elwert, G. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The limb flare of November 18, 1980, 14:51 UT, was investigated on the basis of x ray images taken by the Hard X-ray Imaging Spectrometer (HXIS) and of x ray spectra from the Hard X-Ray Burst Spectrometer (HXRBS) aboard the Solar Maximum Mission (SMM). The impulsive burst was also recorded at microwave frequencies between 2 and 20 GHz whereas no optical flare and no radio event at frequencies below 1 GHz were reported. The flare occurred directly at the SW limb of the solar disk. Taking advantage of the spatial resolution of HXIS images, the time evolution of the x radiation originating from relatively small source regions can be studied. Using Monte Carlo computations of the energy distribution of energetic electrons traversing the solar plasma, the bremsstrahlung spectra produced by the electrons were derived.

39831 (N—87-21785, pp vp) **Study of starting time in great hard X-ray flares.** Klein, K.L.; Pick, M.; Magun, A. (Institut fuer Angewandte Physik, Bern, Switzerland). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

An analysis of the starting time in ten great hard x ray bursts observed with the X-Ray Burst Spectrometer (HXRBS) is presented. It is shown that the impulsive phase of nine of them is composed of a preflash phase, during which the burst is observed up to an energy limit ranging from some tens of keV to 200 keV, followed ten to some tens of seconds afterwards by a flash phase, where the count rate rises simultaneously in all detector channels. For two events strong gamma-ray line emission is observed and is shown to start close to the onset of the flash phase.

39832 (N—87-21785, pp vp) **Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations.** Li, C.S.; Jiang, S.Y. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

In order to understand the relationship between fast hard x ray bursts (HXRB) and microwave bursts (MWB), data were used from the following publications: NASA Technical Memorandum 84998; Solar Geological Data (1980 to 1983); monthly report of Solar Radio Emission; and NASA and NSF: Solar Geophysical Data (1980 to 1983). For analyzing individual events, the criterion of the same event for HXRB and MWB is determined by peak time difference. There is a good linear correlation between the physical parameter of HXRB and MWB.

39833 (N—87-21785, pp vp) **Microwave and hard x ray emissions during the impulsive phase of solar flares: nonthermal electron spectrum and time delay.** Gu, Y.M.; Li, C.S. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

On the basis of the summing-up and analysis of the observations and theories about the impulsive microwave and hard x ray bursts, the correlations between these two kinds of emissions were investigated. It is shown that it is only possible to explain the optically-thin microwave spectrum and its relations with the hard x ray spectrum by means of the nonthermal source model. A simple nonthermal trap model in the mildly-relativistic case can consistently explain the main characteristics of the spectrum and the relative time delays.

39834 (N—87-21785, pp vp) **Hard x ray imaging observation of fluctuating bursts.** Ohki, K.; Harada, M. (Tokyo Science Univ., Japan). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Measurements were done to obtain the one-dimensional sizes of rapidly fluctuating bursts with fast spikes whose rise times are typically about one second, and in some extreme cases less than 0.1 second. The results of two bursts with fast spikes are presented. One has a soft spectrum, and the other has a very hard spectrum. The measured one-dimensional size of both events indicates relatively a small size and simple structure. It can be said, however, that the source size is not so small as expected from its rapid time variations. Therefore, a thermal explanation of these bursts seems to be excluded.

39835 (N—87-21785, pp vp) **Hard x ray delays.** Schwartz, R.A. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

High time resolution hard x ray rates with good counting statistics over 5 energy intervals were obtained using a large area balloon-borne scintillation detector during the 27 June 1980 solar flare. The impulsive phase of the flare was comprised of a series of major bursts of several to several tens of seconds long. Superimposed on these longer bursts are numerous smaller approximately 0.5 to 1.0 second spikes. The time profiles for different energies were cross-correlated for the major bursts. The rapid burst decay rates and the simultaneous peaks below 120 keV both indicate a rapid electron energy loss process. Thus, the flux profiles reflect the electron acceleration/injection process. The fast rate data was obtained by a burst memory in 8 and 32 msec resolution over the entire main impulsive phase. These rates will be cross-correlated to look for short time delays and to find rapid fluctuations. However, a cursory examination shows that almost all fluctuations, down to the 5% level, were resolved with 256 msec bins.

39836 (N—87-21785, pp vp) **Fast fluctuations of soft x rays from active regions.** Simnett, G.F.; Dennis, B.R. (Birmingham Univ., England). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A selection of short lived small soft X-ray bursts is studied using data from the Hard X-ray Imaging Spectrometer (HXIS), and the results are compared with the data from the Hard X-Ray Burst Spectrometer (HXRBS) with a view to understanding conditions at the onset of flares. Short-lived events provide an opportunity to study the radiation from the primary energy transfer process without confusion from the slowly-varying thermal x ray emission which characterizes the decay of a large flare. The fast decay of the soft x rays, only a few tens of seconds, suggests that they occur in the dense chromosphere. The results indicate that the short events may be signatures of several different phenomena, depending on their characteristics. Some events occur in association with reverse-drift type III bursts and simultaneous flaring elsewhere on the Sun, thus suggesting dumping of particles accelerated at a remote site. Some events have hard x ray bursts and normal type III bursts associated with them, while others have neither. The latter events place strong constraints on the nonthermal electron population present.

39837 (N—87-21785, pp vp) **Extremely rapid radio spikes in flares: a review.** Benz, A.O. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Radio spikes of a few to tens of milliseconds of the solar radio emission have recently seen a surge of interest of theoreticians who are fascinated by their high brightness temperature of up to 10 to the 15th power K, their association with hard x ray bursts, and a possibly very intimate relation to electron acceleration. Their bandwidth and global distribution in frequency were quantitatively

measured only recently. This review is intended to emphasize the considerable extend of old and new observational knowledge which is hardly touched upon by theory. The wide range of spike observations is summarized and brought into perspective of recent models. It is concluded that spikes yield a considerable potential for the diagnostics of energetic particles, their origin, and history in astrophysical plasmas.

39838 (N—87-21785, pp vp) **Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts.** Enome, S.; Orwig, L.E. (Nagoya Univ., Japan). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Results are reported of an initial comparison of solar narrow-band decimeter wave spike bursts with corresponding x ray events for 25 solar flares. Contrary to the rather straighforward temporal and spatial relations which exist between typical impulsive microwave and x ray bursts, narrow-band decimeter wave spike bursts show complex temporal structure relative to the associated x ray features. The time delay between the hard x ray and microwave emission peaks varies from -2 to 8 seconds. The associated x ray events are very weak in intensity, are spectrally very soft, and do not show any peculiar spectral features. Although the totai number of bursts is small, it is found that decimeter spike bursts are 100 to 1000 times stronger than normal impulsive microwave bursts for the same observed amount of hard x ray emission. This feature, supplemented by the fact that 100% circular polarization is observed, strongly supports a maser origin for the decimeter spike bursts.

39839 (N—87-21785, pp vp) **Position measurements of rapidly fluctuating microwave bursts.** Kai, K.; Nakajima, H. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

It was investigated whether microwave source positions change while the total fluxes of hard x rays and microwaves show remarkable rapid fluctuations of the order of seconds. The position measurements were made in one dimension (east-west direction) with the 17 GHz interferometer at Nobeyama. Position changes greater than a few arc seconds can be detected. The result shows that significant position changes are found for five of seven bursts but that no position changes greater than 3 arc seconds are found for the remaining two bursts.

39840 (N—87-21785, pp vp) **Role of narrowband dm-spikes in solar flares.** Karlicky, M. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The main observational characteristics of narrowband dm-spikes are summarized. Since the spikes are observed in typical sequences of radio bursts, a global model of these bursts is presented. The intensity of the magnetic field in the spike source region, which is of principal importance, is discussed.

39841 (N—87-21785, pp vp) **Possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard x ray emission of a solar event.** Correia, E.; Kaufmann, P.; Costa, J.E.R.; Zodivaz, A.M.; Dennis, B.R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The solar burst of 21 May 1984, presented a number of unique features. The time profile consisted of seven major structures (seconds), with a turnover frequency of greater than or approximately 90 GHz, well correlated in time to hard x ray emission. Each structure consisted of multiple fast pulses (0.1 seconds), which were analyzed in detail. A proportionality between the repetition rate of the pulses and the burst fluxes at 90 GHz and greater than or approximately 100 keV hard x rays, and an inverse proportionality between repetition rates and hard x ray power law indices were found. A synchrotron/inverse Compton model was applied to explain the emission of the fast burst structures, which appear to be possible for the first three or four structures.

39842 (N—87-21785, pp vp) **Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard x rays.** Zodivaz, A.M.; Kaufmann, P.; Correia, E.; Costa, J.E.R.; Takakura, T.; Cliver, E.W.; Tapping, K.F. (Tokyo Univ., Japan; Air Force Geophysics Lab., Hanscom AFB, MA; National Research Council of Canada, Ottawa, Ontario). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A solar burst was observed with high sensitivity and time resolution at cm-mm wavelengths by two different radio observatories (Itapetinga and Algonquin), with high spectral time resolution at dm-mm wavelengths by patrol instruments (Sagamore Hill), and at hard x rays (HXM Hinotori). At the onset of the major burst time structure there was a rapid rise in the spectral turnover frequency (from 5 to 15 GHz), in about 10s, coincident to a reduction of the spectral index in the optically thin part of the spectrum. The burst maxima were not time coincident at the optically thin radio frequencies and at the different hard x ray energy ranges. The profiles at higher radio frequencies exhibited better time coincidence to the high energy x rays. The hardest x ray spectrum (-3) coincided with peak radio emission at the higher frequency (44 GHz). The event appeared to be built up by a first major injection of softer particles followed by other injections of harder particles. Ultrafast time structures were identified as superimposed on the burst emission at the cm-mm high sensitivity data at x rays, with predominant repetition rates ranging from 2.0 to 3.5 Hz.

39843 (N—87-21785, pp vp) **Quasi-periodic pulsations in solar hard x ray and microwave flares.** Kosugi, T.; Kiplinger, A.L. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

For more than a decade, various studies have pointed out that hard x ray and microwave time profiles of some solar flares show quasi-periodic fluctuations or pulsations. Nevertheless, it was not until recently that a flare displaying large amplitude quasi-periodic pulsations in x rays and microwaves was observed with good spectral coverage and with a sufficient time resolution. The event occurred on June 7, 1980, at approximately 0312 UT, and exhibits seven intense pulses with a quasi-periodicity of approximately 8 seconds in microwaves, hard x rays, and gamma-ray lines. On May 12, 1983, at approximately 0253 UT, another good example of this type of flare was observed both in hard x rays and in microwaves. Temporal and spectral characteristics of this flare are compared with the event of June 7, 1980. In order to further explore these observational results and theoretical scenarios, a study of nine additional quasi-periodic events were incorporated with the results from the two flares described. Analysis of these events are briefly summarized.

39844 (N—87-21785, pp vp) **Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares.** Li, C.; Jiang, S.; Li, H.; Fu, Q. (Academia Sinica, Beijing, China). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A tentative model is proposed to account for some features of the microwave millisecond spike emission and its links with the physical processes of associated phenomena during the impulsive phase of large flares by comparing the optical, radio, and x ray observations on May 16, 1981 to those on October 12, 1981.

39845 (N—87-21785, pp vp) **Microwave spectrum of solar millisecond spikes.** Staehli, M.; Magun, A. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The microwave radiation from solar flares sometimes shows short and intensive spikes which are superimposed on the burst continuum. In order to determine the upper frequency limit of their occurrence and the circular polarization, a statistical analysis was performed on digital microwave observations from 3.2 to 92.5 GHz. Additionally, fine structures were investigated with a fast 32-channel spectrometer at 3.47 GHz. It was found that about 10 percent of the bursts show fine structures at 3.2 and 5.2 GHz, whereas none occurred above 8.4 GHz. Most of the observed spikes were very short and their bandwidth varied from below 0.5 MHz to more than 200 MHz. Simultaneous observations at two further frequencies showed no coincident spikes at the second and third harmonic. The observations can be explained by the theory of electron cyclotron masering if the observed bandwidths are determined by magnetic field inhomogeneities or if the rise times are independent of the source diameters. The latter would imply source sizes between 50 and 100 km.

39846 (N—87-21785, pp vp) **Solar VLBI.** Tapping, K.F.; Kuijpers, J. (Utrecht State Univ., Netherlands). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

In April, 1981, radio telescopes at Dwingeloo (The Netherlands) and Onsala (Sweden) were used as a long-baseline interferometer at a wavelength of 18 cm. The baseline of 619 km gave a spatial resolution on the Sun of about 45 km. The major problems of Solar Very Long Baseline Interferometry are discussed.

39847 (N—87-21785, pp vp) **Temporal frequency of radio emissions for the April 25, 1984 flare.** Wells, G.D.; Hausman, B.A.; Kroehl, H.W. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The USAF Radio Solar Telescope Network (RSTN) data allow performance of time series analysis to determine temporal oscillations as low as three seconds. The X13/3B flare, which erupted in region 4474 (S12E43) on the 24 to 25 of April 1984, was selected. The soft x rays, 1 to 8 A, remained above X-levels for 50 minutes and the radio emissions measured at Learmonth Solar Observatory reached a maximum of 3.15 x 10 to the 5th power SFUs at 410 MHz at 0000UT. A power spectral analysis of the fixed frequency RSTN data from Learmonth shows possible quasi-periodic fluctuations in the range two to ten seconds. Repetition rates or quasi-periodicities, in the case of the power spectral analysis, generally showed the same trends as the average solar radio flux at 245 and 8800 MHz. The quasi-periodicities at 1415 MHz showed no such trends.

39848 (N—87-21785, pp vp) **Solar microwave millisecond spike at 2.84 GHz.** Fu, Q.J.; Jin, S.Z.; Zhao, R.Y.; Zheng, L.P.; Liu, Y.Y.; Li, X.C.; Wang, S.L.; Chen, Z.J.; Hu, C.M. (Academia Sinica, Beijing, China). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Using the high time resolution of 1 ms, the data of solar microwave millisecond spike (MMS) event was recorded more than two hundred times at the frequency of 2.84 GHz at Beijing (Peking) Observatory since May 1981. A preliminary analysis was made. It can be seen from the data that the MMS-events have a variety of the fast activities such as the dispersed and isolated spikes, the clusters of the crowded spikes, the weak spikes superimposed on the noise background, and the phenomena of absorption. The marked differences from that observed with lower time resolution are presented. Using the data, a valuable statistical analysis was made. There are close correlations between MMS-events and hard x ray bursts, and fast drifting bursts. The MMS events are highly dependent on the type of active regions and the magnetic field configuration. It seems to be crucial to find out the accurate positions on the active region where the MMS-events happen and to make co-operative observations at different bands during the special period when specific active regions appear on the solar disk.

39849 (N—87-21785, pp vp) **Sensitivity of H alpha profiles to rapid electron beam fluctuations.** Canfield, R.C.; Gayley, K.G. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

In order to understand the temporal relationship between H alpha and hard x ray emission predicted by the nonthermal electron thick target model of impulsive-phase energy transport the time-dependent theoretical H alpha profiles were computed for the dynamic model atmospheres of Fisher, Canfield, and McClymont, which simulate the effects of an impulsively initiated power-law beam of electrons. On the basis of the physical analysis it was expected that a very rapid H alpha response to an instantaneous increase in the flux of a nonthermal deka-keV electron beam, as compared to the timescale associated with the propagation of these electrons over characteristic flare coronal loop spatial scales. It was concluded that observational efforts to test the thick target nonthermal electron model through detection of impulsive H alpha brightenings associated with impulsive hard x ray or microwave bursts should initially focus attention on the H alpha line center. Additional simultaneous blue-wing measurements will have substantial diagnostic potential.

39850 (N—87-21785, pp vp) **Search for fast variations in the Fe XXI emission during solar flares.** Cheng, C.C. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A search for fast variations in the Fe XXI emission was made for ten flares using the Fourier analysis. Three examples were described. The main results are summarized.

39851 (N—87-21785, pp vp) **Fast temporal correlation between hard x ray and ultraviolet continuum brightenings.** Machado, M.E.; Mauas, P.J. (Instituto de Astronomia y Fisica del Espacio, Buenos Aires, Argentina). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Recent Solar Maximum Mission (SMM) observations have shown fast and simultaneous increases in hard x rays (HXR, E25 keV) and ultraviolet continuum (UVC, lambda lambda approx. equals 1600 and 1388 A) radiation. A simple and natural explanation is given for this phenomenon to happen, which does not involve extreme conditions for energy transport processes, and confirms earlier results on the effect of XUV photoionization in the solar atmosphere.

39852 (N—87-21785, pp vp) **Comparison of solar hard x ray and UV line and continuum bursts with high time resolution.** Orwig, L.E.; Woodgate, B.E. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The close temporal correlation between the ultraviolet line emission from OV (lambda 1371A) and hard x rays above 30 keV has been previously established from a comparison of data sets from the Ultraviolet Spectrometer and Polarimeter (UVSP) and Hard X-Ray Burst Spectrometer (HXRBS) instruments on Solar Maximum Mission (SMM). Corresponding features were found to be coincident to within 1 s. Following the SMM repair, similar measurements were made for a flare occurring on May 20, 1984, at 0259 UT, this time with UVSP observing in the continuum near 1600A with much higher time resolution (75ms). The simultaneity of several features in this flare were established to better than 0.1 s, thus reinforcing the close relationship between hard x ray and UV emission. Following the repair of the UVSP wavelength drive, similar measurements were repeated for a flare occurring at 0148 UT on April 24, 1985. This event was observed simultaneously in the OV line, the UV continuum and in hard x rays by the same SMM instruments. Temporal comparisons of the three data sets show that, for a few selected features, simultaneity of the hard x ray and UV

emissions does exist. However, cross-correlation analyses of the entire data sets indicate that there is a trend for the fastest OV emission features to be delayed with respect to the hard x rays by approx. 260 ms. On the other hand the fast OV and UV continuum features are simultaneous to within the instrumental uncertainty. The combined results have established the close relationship of the impulsive phase hard x ray and UV continuum and OV line emissions. They lend support to the argument that both the hard x ray and UV radiations originate low in the solar atmosphere.

39853 (N—87-21785, pp vp) **OV and hard x-rays, observations and model calculations.** Poland, A.I.; Mariska, J.T. (Naval Research Lab., Washington, DC). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

An amalgamation of two published works that discuss the observation and theoretical calculations of OV (T approx. 250,000K) and hard x rays (30 to 100keV) emitted during flares are presented. The papers are by Poland, et al, (1984) and Mariska and Poland (1985). The observations of hard x rays and OV show that the excitation processes for each type of emission are closely coupled. Except for small differences the two types of emission rise and fall together during a flare. Model calculations are able to reproduce this behavior to a large extent, only when conductive processes do not dominate the energy transport processes.

39854 (N—87-21785, pp vp) **Rapid soft x ray fluctuations in solar flares observed with the x ray polychromator.** Zarro, D.M.; Saba, J.L.R.; Strong, K.T. (Lockheed Missiles and Space Co., Palo Alto, CA). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Three flares observed by the Soft X-Ray Polychromator on the Solar Maximum Mission were studied. Flare light curves from the Flat Crystal Spectrometer and Bent Crystal Spectrometer were examined for rapid signal variations. Each flare was characterized by an initial fast (less than 1 min) burst, observed by the Hard X-Ray Burst Spectrometer (HXRBS), followed by softer gradual x ray emission lasting several minutes. From an autocorrelation function analysis, evidence was found for quasi-periodic fluctuations with rise and decay times of 10 s in the Ca XIX and Fe XXV light curves. These variations were of small amplitude (less than 20%), often coincided with hard x ray emissions, and were prominent during the onset of the gradual phase after the initial hard x ray burst. It is speculated that these fluctuations were caused by repeated energy injections in a coronal loop that had already been heated and filled with dense plasma associated with the initial hard x ray burst.

39855 (N—87-21785, pp vp) **Soft x ray oscillations during the flare of 7 August 1972.** Thomas, R.J.; Neupert, W.M.; Thompson, W.T. (Applied Research Corp., Landover, MD). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Unique observations from OSO-7 of the intense flare on 7 August 1972 are presented, showing 1.6 second oscillations in it's soft x ray emission which are long enduring, extremely regular, and initially of large amplitude. For approximately 20 minutes just after flare maximum, the x ray intensity of an area 20 arc second square near the flare's core was monitored with 160 millisecond time resolution in two channels, 2-8A and 8-16A. Each channel recorded over 700 cycles of the x ray oscillations, which remained remarkably stable in phase and period throughout the entire observations, but with gradually diminishing amplitude. The observed period does not correspond to any known operational periodicity in either the instrument or the spacecraft and cannot be attributed to aliasing with any other oscillatory component. Channel ratios indicate that both the temperature and electron density of the emitting plasma are enhanced at the peak of each cycle. There is indirect evidence that the x ray pulsations are occurring only in a relatively small portion of an elongated feature, presumed to be a loop or arcade of loops.

39856 (N—87-21785, pp vp) **Rapid changes in H alpha-flares correlated with microwaves.** Wuelser, J.P.; Kaempfer, N. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The time evolution of several flares was studied in H alpha with a time resolution of 1.4 seconds. The time profiles of the line-center intensity show fast fluctuations and spikes. During the impulsive phase, prominent spikes occur in different kernels and they are correlated with microwave and hard x ray spikes. Spectral resolved observations show major changes of the ratio between H alpha line width and H alpha linecenter intensity at time scales in the order of 1 minute. No significant fluctuations occurred at shorter time scales.

39857 (N—87-21785, pp vp) **Plasma turbulence and impulsive UV line emission in solar flares.** Brown, J.C. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Observations show that hard x ray burst and UV lines rise and fall simultaneously on time scales of seconds. Hydrodynamic simulations of beam-heated atmospheres, based on collisional transport, however, produce only a gradual fall in UV emission, when the beam flux falls, due to the long time scale of conductive relaxation. It is suggested that this discrepancy might be explained by onset of plasma turbulence driven by the strong heat flux or by the beam return current going unstable. Such turbulence greatly reduces electrical and thermal conductivities. Fall in electrical conductivity reduces the hard x ray flux by enhanced ohmic dissipation of the return current, while fall in thermal conductivity may cause the UV line to fall by reducing the transition region thickness.

39858 (N—87-21785, pp vp) **Electron-cyclotron maser and solar microwave millisecond spike emission.** Li, H.W.; Li, C.S.; Fu, Q.J. (Academia Sinica, Beijing, China). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

An intense solar microwave millisecond spike emission (SMMSE) event was observed on May 16, 1981 by Zhao and Jin at Beijing Observatory. The peak flux density of the spikes is high to 5 x 100,000 s.f.u. and the corresponding brightness temperature (BT) reaches approx. 10 to the 15th K. In order to explain the observed properties of SMMSE, it is proposed that a beam of electrons with energy of tens KeV injected from the acceleration region downwards into an emerging magnetic arch forms so-called hollow beam distribution and causes electron-cyclotron maser (ECM) instability. The growth rate of second harmonic X-mode is calculated and its change with time is deduced. It is shown that the saturation time of ECM is t sub s approx. equals 0.42 ms and only at last short stage (delta t less than 0.2 t sub s) the growth rate decreases to zero rather rapidly. So a SMMSE with very high BT will be produced if the ratio of number density of nonthermal electrons to that of background electrons, n sub s/n sub e, is larger than 4 x .00001.

39859 (N—87-21785, pp vp) **Effect of beam-driven return current instability on solar hard x ray bursts.** Cromwell, D.; Mcquillan, P.; Brown, J.C. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The problem of electrostatic wave generation by a return current driven by a small area electron beam during solar hard x ray bursts is discussed. The marginal stability method is used to solve numerically the electron and ion heating equations for a prescribed beam current evolution. When ion-acoustic waves are considered, the method appears satisfactory and, following an initial

phase of Coulomb resistivity in which T sub e/T sub i rise, predicts a rapid heating of substantial plasma volumes by anomalous ohmic dissipation. This hot plasma emits so much thermal bremsstrahlung that, contrary to previous expectations, the unstable beam-plasma system actually emits more hard x rays than does the beam in the purely collisional thick target regime relevant to larger injection areas. Inclusion of ion-cyclotron waves results in ion-acoustic wave onset at lower T sub e/T sub i and a marginal stability treatment yields unphysical results.

39860 **(PB—87-186375/XAB) Solar-Geophysical Data Number 511, March 1987. Part 1 (prompt reports). Data for February, January 1987 and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Mar 1987. 118p. (SG—511-PT-1). NTIS, PC A06/MF A01.

See also PB—87-162574 and PB—87-186383.

Contents include: Detailed index for 1986-1987; Data for February 1987-- (IUWDS alert periods (Advance and worldwide); Solar-activity indices; Solar flares; Solar radio emission, Stanford mean solar magnetic field); Data for January 1987-- (Solar-active regions, Sudden ionospheric disturbances; Solar radio spectral observations; Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio-propagation indices); Late data-- (Solar-activity indices, Pioneer XII interplanetary magnetic field magnitudes; Cosmic-ray measurements by neutron monitor Kiel/Tokyo July 1986, Geomagnetic indices November-December 1986, Calcium-plage data September-November 1986).

39861 **(RRK—86-5) Group of motions in a special anisotropic universe specified by Ishihara's metric.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702552.

The group of motions in a special anisotropic universe studied by H. Ishihara is worked out. It is shown that the group of motions in the universe is of a 4-parameters. Finite forms of the corresponding coordinate transformations are also obtained.

39862 **(RRK—86-16) Spatial distance of a non-static stellar object.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702553.

In terms of Hernandez and Misner's metric for a non-static spherically symmetric stellar object, we deal with three invariant spatial distances from C (at the center r = 0) to an external observer O, i.e., Newman-Goldberg's d(CO vector), Nariai's d tilde(CO vector) and the luminosity distance d/sub L/(CO vector). It is shown that these distances should obey the relation (dd/sub L/)/ sup 1/2/ = d tilde.

39863 **(RRK—86-17) Mach's principle in the Brans-Dicke cosmology. The case of a closed universe.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702554.

As a sequel to a previous paper on the problem of Mach's principle in the Brans-Dicke cosmology, the case of a closed universe is dealt with by the use of our retarded bi-scalar Green's function. It is shown that, irrespective of whether the universe is elliptic or spherical, Mach's principle in the sense of Dicke may hold in the universe, provided that the scale factor a(t) and their scalar field phi(t) satisfy some initial conditions.

39864 **(RRK—86-28) Gauge-invariant cosmological density perturbations.** Sasaki, M. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702555.

Gauge-invariant formulation of cosmological density perturbation theory is reviewed with special emphasis on its geometrical aspects. Then the gauge-invariant measure of the magnitude of a given perturbation is presented.

39865 **(RRK—86-29) Large scale quantum fluctuations in the inflationary universe.** Sasaki, M. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702556.

Quantum fluctuations of an inflation-driving scalar field are evaluated in a way manifestly independent of the choice of coordinate gauge conditions. It is found that the dynamical degree of freedom of the fluctuating field is represented in terms of a nearly massless conformal scalar field in the unperturbed de Sitter background. Implications of the result are discussed. In particular, it is argued that classical cosmological density perturbations may not be generated in the sense as discussed in the literature.

39866 **(UCRL—53793) Resonant Alfven wave instabilities driven by streaming fast particles.** Zachary, A. (Lawrence Livermore National Lab., CA (USA)). 8 May 1987. Contract W-7405-ENG-48. 248p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87011158.

A plasma simulation code is used to study the resonant interactions between streaming ions and Alfven waves. The medium which supports the Alfven waves is treated as a single, one-dimensional, ideal MHD fluid, while the ions are treated as kinetic particles. The code is used to study three ion distributions: a cold beam; a monoenergetic shell; and a drifting distribution with a power-law dependence on momentum. These distributions represent: the field-aligned beams upstream of the earth's bow shock; the diffuse ions upstream of the bow shock; and the cosmic ray distribution function near a supernova remnant shock. 92 refs., 31 figs., 12 tabs.

39867 **(UCRL—96673) Models of optical and soft x-ray spectra in AM Her stars.** Langer, S.H. (Lawrence Livermore National Lab., CA (USA)). 25 May 1987. Contract W-7405-ENG-48. 8p. (CONF-8705155—1). NTIS, PC A02. File Number DE87011346.

From North American workshop on cataclysmic variables; Aspen, CO, USA (25 May 1987).

The AM Her systems are widely believed to be cataclysmic variable systems in which the white dwarf has a magnetic field strong enough to lock the white dwarf to the companion star. The magnetic field channels the accretion flow to the magnetic polar caps of the white dwarf where the gas passes through a strong shock and the accretion energy is released. The continuum spectra of the AM Her systems have three major components: the ir/optical component, the EUV/soft x-ray component, and the hard x-ray component. Models of the AM Her systems generally agree that the hard x-rays are free-free radiation emitted by the hot postshock gas and that the optical component is electron cyclotron emission from the postshock gas. The soft x-ray component is less well understood, primarily because it is very soft (temperature less than 100 eV) and thus is very difficult to measure accurately with current instruments. Models agree that some soft x-ray emission will arise from hard x-rays and cyclotron radiation that is absorbed at the stellar surface and re-radiated, but other sources of soft x-rays have also been suggested. Thus it is important to develop models for the soft x-ray spectrum. This paper presents some preliminary results on the emission in all spectral bands based on numerical models of the accretion flow. 4 figs.

39868 **Underground science initiatives at Los Alamos.** Simmons, L.M. Jr. (Los Alamos National Lab., NM). *Nuovo Cimento della Societa Italiana di Fisica,* [*Sezione*] *C;* 9: No. 2, 293-307(Mar-Apr 1986). (CONF-8505359—).

From 1. symposium on underground physics; Saint-Vencent, Italy (25 May 1985).

Recently, the Los Alamos National Laboratory has proposed two major new initiatives in underground science. Following the dissolution of the original gallium solar-neutrino collaboration, Los Alamos has formed a new North American collaboration. We briefly review the rationale for solar-neutrino research, outline the proposal and new Monte Carlo simulations, and describe the candidate locations for the experiment. Because there is no deep underground site in North America suitable for a dedicated permanent laboratory, Los Alamos has conducted a survey of possible sites and devel-

oped a proposal to create a new National Underground Science Facility. This paper also reviews that proposal.

39869 **Neutrinos from gravitational collapse.** Schramm, D.N.; Mayle, R.; Wilson, J.R. (Univ. of Chicago, IL; Univ. of California, Berkeley; Livermore National Lab., CA). *Nuovo Cimento della Societa Italiana di Fisica, [Sezione] C;* 9: No. 2, 443-450(Mar-Apr 1986). (CONF-8505359—).

From 1. symposium on underground physics; Saint-Vencent, Italy (25 May 1985).

Also published as report FNAL/Pub—86/81-A, May 1986, 36 p.

A review is made of neutrino fluxes produced by gravitational collapse events (type-II supernovae). Recent work of Mayle, Wilson and Schramm is used to examine those aspects of neutrino signal which are relatively independent of the collapse model and those aspects which are sensitive to model details. A discussion of the antineutrino background from the integral of all collapse events is also presented.

39870 **Early results from the JACEE balloon project.** Burnett, T.H.; Dake, S.; Fuki, M.; Gregory, J.C.; Hayashi, T.; Holynski, R.; Iwai, J.; Jones, W.V.; Jurak, A.; Lord, J.J. pp 641-649 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Balloon-borne emulsion chambers are being used to study the nuclear interactions, energy spectra and chemical composition of cosmic rays over the approximate interval 2 - 200 TeV. The three balloon flights to date have provided the first direct measurements of the proton and helium spectra at these energies. Preliminary data on the chemical composition of heavier nuclei has also been obtained, albeit with poor statistics because of the limited exposure. The investigations show that hadron-nucleus interactions at a mean energy of about 45 TeV are consistent with extrapolations from lower energies. Nucleus-nucleus interactions, on the other hand, seem to exhibit some unexpected characteristics. One Si-AgBr interaction at about 5 TeV/nucleon produced about 1000 charged particles, and several events indicate large transverse momentum particle production for a few secondaries.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 39860

39871 **(AD-A—179712/5/XAB) Instrumentation for infrared airglow clutter. Final report, July 1984-May 1986.** Ulwick, J.C. (Utah State Univ., Logan (USA). Center for Space Engineering). 10 Mar 1987. 31p. (CSE—87-012). NTIS, PC A03/MF A01.

Availability: Document partially illegible.

Two measurements systems were completed to provide the capability to make high-resolution spatial and temporal measurements of infrared structures of the aurorae & airglow. The two systems are: 1) GAZER (Graphics Aided Zonal Energy Recorder) - a low-light-level, wide-angle TV imaging and recording system with the capability of storing information regarding absolute-intensity levels of the image for subsequent recall and analysis; and 2) Scanning IR Radiometer - a microprocessor-controlled tracking mount which drives an IR radiometer through programmable repeatable scan patterns to provide sky maps of the temporal and space small- and large-scale inhomogeneities.

39872 **(AD-A—179910/5/XAB) Study of plasma irregularities in the high-latitude region. Final report, 19 June 1984-30 September 1986.** Weimer, D.R.; Anderson, P.B.; Greenspan, M.E.; Basinska-Lewin, E.M.; James, J.H. (Regis Coll., Weston, MA (USA). Research Center). 27 Oct 1986. 106p. NTIS, PC A06/MF A01.

Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

A summary is given of the work completed under contract F19628-84-C-0126. This work included the engineering of space-qualified instruments, data processing services, and scientific study of high-latitude plasma irregularities and the physics of the aurorae. Design work has been done on a series of plasma instruments for the Defense Meteorological Satellite Program (DMSP), the combined Release and Radiation Effects Satellite (CRRES), the Beam Ejection Rocket Technology (BERT) and Ejected Rocket Nosecone to measure induced Emissions (ERNIE) sounding rocket program, and the interactions Measurements Payload for Shuttle (IMPS). The function of the Special Sensor for Ions, Electrons, and Scintillations (SSIES) is described in detail. Computer programs were written to process DMSP magnetometer data, and DMSP plasma density measurements were processed to produce a model of the topside ionosphere. A scientific study was conducted with HILAT data in order to produce an empirical description of high-latitude plasma irregularity production and transport. Data from HILAT has also used to study small-scale processes on the auroral dayside cusp region. Both HILAT and Dynamics Explorer 1 data were used to study auroral electrodynamics in the ionosphere and above to the auroral acceleration region. Research is in progress on a study of the coupling between the magnetotail and the auroral ionosphere using data from both the European Incoherent Scatter radar facility (EISCAT) and the Active Magnetosphere Particle Tracer Explorer Ion Release Module AMPTE IRM.

39873 **(AD-A—179972/5/XAB) Search for the plasma processes associated with perpendicular ion heating. Technical report (Final).** Kintner, P.M.; Gorney, D.J. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 17 Feb 1987. 31p. (TR—0086(6940-06)-9). NTIS, PC A03/MF A01.

The satellite S3-3 data set was examined for examples of perpendicular ion acceleration with simultaneous broadband plasma-wave data. One event was found. Plasma waves in the frequency range for lower hybrid resonance (LHR) waves and in the frequency range for Doppler-shifted O(+) ion cyclotron waves modestly correlated with the perpendicular ion acceleration, although their electric-field amplitudes were less than that assumed in present theories of ion acceleration: about 0.2-6.0 mV/m (rms) for the LHR waves and 4-9 mV/m (rms) for the possible Doppler-shifted O^+ cyclotron waves. Plasma waves propagating above the LHR frequency briefly reached a value of 10 mV/m (rms). No evidence was found for the existence of H(+) cyclotron waves during the period of perpendicular ion acceleration. The thermal or superthermal electron field-aligned current density (Ee $<$ 170 eV), estimated by subtracting the current density measured by the electron spectrometer from that measured by the magnetrometer, correlated very well with the period of perpendicular ion acceleration.

39874 **(LA—10986-MS) Observations of prolonged ionospheric anomalies following passage of an infrasound pulse through the lower thermosphere.** Jacobson, A.R.; Carlos, R.C. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012706.

We have studied the Doppler spectra of E-layer vertical-incidence HF soundings around the time of passage of a brief (duration ~10 s) acoustic shock. Following the exit of the shock from the reflection volume, there occurred a several-minute episode of spectral derangement. We have analyzed this derangement in some detail and have related it to other studies of possibly the same phenomenon. 18 refs., 10 figs.

39875 **(N—87-20689) Yosemite conference on ionospheric plasma in the magnetosphere: sources, mechanisms and consequences, meeting report.** Gallagher, D.L.; Burch, J.L.; Klumpar, D.M.; Moore, T.E.; Waite, J.H. Jr. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Feb 1987. 11p. (NASA-TM—86589; NAS—1.15:86589; CONF-8602133—Summ.). NTIS, PC A02/MF A01.

From Yosemite conference on ionospheric plasma in the magnetosphere: sources, mechanisms and consequences; Yosemite, CA, USA (3 Feb 1986).

The sixth biennial Yosemite topical conference and the first as a Chapman Conference was held on February 3 to 6, 1986. Although the solar wind was once thought to dominate the supply of

plasma in the Earth's magnetosphere, it is now thought that the Earth's ionosphere is a significant contributor. Polar wind and other large volume outflows of plasma have been seen at relatively high altitudes over the polar cap and are now being correlated with outflows found in the magnetotail. The auroral ion fountain and cleft ion fountain are examples of ionospheric sources of plasma in the magnetosphere, observed by the Dynamics Explorer 1 (DE 1) spacecraft. The conference was organized into six sessions: four consisting of prepared oral presentations, one poster session, and one session for open forum discussion. The first three oral sessions dealt separately with the three major topics of the conference, i.e., the sources, mechanisms, and consequences of ionospheric plasma in the magnetosphere. A special session of invited oral presentations was held to discuss extraterrestrial ionospheric/magnetospheric plasma processes. The poster session was extended over two evenings during which presenters discussed their papers on a one-on-one basis. The last session of the conferences was reserved for open discussions of those topics or ideas considered most interesting or controversial.

39876 **Propagation of a transient electromagnetic disturbance in an inhomogeneous, collisional, magnetized plasma.** Nalesso, G.; Jacobson, A.R. (Ist. di Elettrotecnica ed Elettronica dell'Univ., Padova, Italy; Los Alamos National Lab., NM). *Nuovo Cimento della Societa Italiana di Fisica, [Sezione] C;* **10**: No. 1, 109-127(Jan-Feb 1987).

The time response of an anisotropic, inhomogeneous magnetized plasma to a time-dependent externally applied electric field is studied. The plasma is considered as a conducting medium embedded in a static magnetic field B_0, with finite and constant parallel conductivity σ/sub parallel/ and normal conductivity σ/sub perpendicular/ /sub to/ exponentially varying; a constant ion polarization conductivity (σ/sub pol/) normal to B_0 is also included. The driving term E_0 is assumed to be normal to the ambient magnetic field, with a space dependence only in the (E_0, B_0)-plane (two-dimensional case). The problem is treated as an initial (in time) and boundary (in space) value problem, and an analytic solution is obtained for the time response of the system to a unit step of electric field; the solution for any other driving field is then given via a convolution integral. This model can be used in particular to study the propagation through the ionosphere of ULF waves generated by the motion of an artificially created ion cloud in the upper F region. Moreover, the mathematical technique is rather general, so it may be used also for different plasma models.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 39350, 40124, 40125, 40134

39877 **(AD-A—179741/4/XAB) Method to obtain time-dependent electron-eigenstate populations with electron collisions and an arbitrary radiation field. Technical report, 1 January 1985-1 July 1986.** Sowle, D.H. (Mission Research Corp., Santa Barbara, CA (USA)). 1 Jul 1986. 115p. (MRC-R—1006). NTIS, PC A06/MF A01.

A computer module was written that solves the time-dependent electron-eigenstate population problem under the influence of electron collisions as well as spontaneous and induced radiative transitions to bound or free states. Degree of ionization is automatically included. Electron velocity distribution must be represented by a Maxwellian. Radiation is represented as photon groups, called features, with flat central regions and Lorentz-like tails. Photon features can be superimposed, so that a rather general line and continuum combination can be represented. Check-out examples discussed in the final section indicate that photoionization may be a more-important phenomenon at high altitude than is generally appreciated.

39878 **(AD-A—179887/5/XAB) Structure and dynamics of excited atoms. Final report (Annual), 1 November 1984-31 October 1986.** Gallagher, T.F. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Feb 1987. 54p. NTIS, PC A04/MF A01.

Research was conducted on the interactions of single atoms and colliding pairs of atoms with strong radiation fields by making quantitative measurements of multiphoton processes involving highly excited atoms in microwave fields. Among results of the research were the discovery that blackbody radiation can be used to measure avoided crossings of energy levels in an electric field, and the first measurements of microwave multiphoton resonances. Resonant collisions of K atoms were also studied and very narrow collisional resonances were observed.

39879 **(AD-A—180051/5/XAB) Influence of atomic recoil on the spectrum of resonance fluorescence from a two-level atom.** Prentiss, M.G.; Ezekiel, S. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 15 Jan 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 35, No. 2, 922-925(15 Jan 1987).

By including the effect of atomic recoil, the fluorescence spectrum for a two-level atom can become asymmetric whether the atom is in a uniform field or in a field gradient. This predicted asymmetry in a field gradient accounts for some of the previously observed but hitherto unexplained asymmetry in the fluorescence spectrum.

39880 **(BNL—39861) Science with multiply-charged ions at Brookhaven National Laboratory.** Jones, K.W.; Johnson, B.M.; Meron, M.; Thieberger, P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 14p. (CONF-870152—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010762.

From Workshop on opportunities for atomic physics using slow, highly-charged ions; Argonne, IL, USA (12 Jan 1987).

Methods for producing multiply-charged ions at different charge states and energies were discussed in the context of the facilities and capabilities that are part of the atomic physics program at Brookhaven. Examples were given of some of the experiments that have been accomplished. It was shown that ions with energies from a fraction of an MeV to ions with an energy of several hundred MeV are necessary to properly investigate the science of low-energy multiply-charged ions. Also discussed was the use of synchrotron photons as a fertile method for extending the field of ionic studies.

39881 **(DOE/ER/13449—T11) Muonic x-ray measurement on the μp sticking probability for muon catalyzed fusion in liquid d-t mixture.** Nagamine, K.; Matsuzaki, T.; Ishida, K.; Hirata, Y.; Watanabe, Y.; Kadono, R.; Miyake, Y.; Nishiyama, K.; Jones, S.E.; Maltrud, H.R. (Tokyo Univ. (Japan). Meson Science Lab.; Institute of Physical and Chemical Research, Wako, Saitama (Japan); Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.; Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy; Los Alamos National Lab., NM (USA)). [1987]. Contract FG02-85ER13449;W-7405-ENG-36. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010968.

A measurement was made for x-rays from muonic ($\mu^-{}^4$He) atoms in order to obtain the μ^- sticking probability for ^{4}He following muon catalyzed fusion (μCF) in a liquid d-t mixture with a high T_2 fraction (30%). Pulsed muon beam was successfully applied to suppress the radiation background due to tritium beta decay. Combined with the neutron time spectrum data, a weak K/sub α/ x-ray peak intensity was converted into an upper limit of the sticking probability of 0.40% with the assumed probability of 25% for excited state formation in muonic (μ^4He) atoms after μCF.

39882 **(DOE/ER/13634—1) Measurements of ionization balance parameters in atomic ions: Progress report for the period 1 September 1986 through 31 May 1987.** Kohl, J.L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Jun 1987. Contract FG02-86ER13634. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010573.

The primary goal of this project is to measure cross sections for dielectronic recombination (DR) in multiply and single charged ions as a function of the external electric field strength. A preliminary measurement of the DR cross section for C^{3+} in a 10 V/cm field has demonstrated that the experiment can determine absolute DR cross sections. Several major improvements in the experimental

arrangement have now been made to increase signal levels by a factor of 18 and to generally improve the stability and reliability of the apparatus. More accurate measurements of DR in C^{3+} as a function of external electric field are planned following tests and evaluation of the new components.

39883 (INIS-mf—10911, pp 73) **Radiative decay of the Kaon hydrogen atom.** Zhong, Y.S.; Thomas, A.W. (Peking Univ., Beijing, China; Adelaide Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39884 **(UCID—21004) Equations describing coherent and partially coherent multilevel molecular excitation induced by pulsed Raman transitions: III.** Shore, B.W.; Sacks, R.; Karr, T. (Lawrence Livermore National Lab., CA (USA)). 18 Feb 1987. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012310.

This memo discusses the equations of motion used to describe multilevel molecular excitation induced by Raman transitions. These equations are based upon the time-dependent Schroedinger equation expressed in a basis of molecular energy states. A partition of these states is made into two sets, those that are far from resonance (and hence unpopulated) and those that are close to resonance, either by one-photon transition or two-photon (Raman) processes. By adiabatic elimination an effective Schroedinger equation is obtained for the resonance states alone. The effective Hamiltonian is expressible in terms of a polarizibility operator.

39885 **(UCID—21119) Measurements of bremsstrahlung produced by energetic electron bombardment of thick targets - II.** Bauer, R.W.; Becker, J.A.; Farley, W.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. File Number DE87013215.

Samples of C (carbon), Al (aluminum), Fe (iron), and U (uranium), 1 inch thick, together with composite samples C/Al, and C/Al,U, have been bombrded by electrons of energy E/sub e/ = 40, 60, and 84 MeV. A status report of measurements of the thick-target bremsstrahlung for angles of 83.5, 96 and 107 degrees is presented.

39886 **Molecular beam photoelectron spectroscopy of SO_2: Geometry, spectroscopy, and dynamics of SO^+_2.** Wang, L.; Lee, Y.T.; Shirley, D.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 5, 2489-2497(1 Sep 1987).

We have reinvestigated the He I (584 A) photoelectron spectroscopy of SO_2 using a supersonic molecular beam. High resolution and rotational cooling allowed us to observe new features and to resolve explicitly the vibrational structure in the first six electronic states of SO^+_2 ion. Improved spectroscopic constants for the ionic states and the adiabatic ionization potentials (IPs) are reported. The vibrational structure of the transition to the X $^2A_1$ ground state was assigned to the ν_1 mode exclusively. Irregularity of the vibrational progression on the high IP side was observed, which indicated a potential barrier (to linearity) along the direction of Q_2 coordinate. The barrier height was estimated to be 0.42 eV (3400 cm^{-1}). Unusual vibrational structure in the A-italic-tilde $^2A_2$ state was observed, due to the principal excitation of the ν_3 mode and the presence of a potential barrier along the Q_3 coordinate. The barrier height was estimated to be less than 220 cm^{-1}. A new progression was resolved in the B-italic-tilde $^2B_2$ state, which was assigned to be a combination of ν_2 with $2\nu_3$. The ν_2 vibration was observed to be strongly coupled with the ν_3 mode. The dynamics of the ion dissociations in the C-italic-tilde, D-italic-tilde, and E-italic-tilde states was discussed in connection with previous works. A satellite band at about 17.5 eV with resolved vibrational structure which consists of two ν_1 vibrational progressions was observed.

39887 **Theory of enhanced energy transfer between molecules embedded in spherical dielectric particles.** Druger, S.D.; Arnold, S.; Folan, L.M. (Department of Chemistry and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Journal of Chemical Physics;* **87**: No. 5, 2649-2659(1 Sep 1987).

The effects of morphological resonances on radiative emission rates and on dipole—dipole energy transfer rates between molecules embedded in aerosol droplets are studied by developing and applying a theory based on electromagnetic solutions for a dielectric sphere. Expressions for the Mie-resonance contributions to the transfer and emission rates are obtained in terms of the experimentally measurable spectral shape functions for the donor and acceptor molecules in the bulk host medium. Mie resonances in droplets of about 10 μm diameter are found to cause only minor changes in the integrated radiative rate, while strongly enhancing the rate and quantum efficiency of energy transfer. Estimates of the enhancement effect and calculations of its dependence on donor/acceptor location yield results consistent with experiment, supporting our interpretation that the observed energy—transfer enhancement occurs via Mie resonances of the nearly spherical droplets, and providing further insight into the Mie-enhanced energy—transfer mechanism.

39888 **CASSCF/CI calculations of electronic states and potential energy surfaces of PtH_2.** Balasubramanian, K. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287). *Journal of Chemical Physics;* **87**: No. 5, 2800-2805(1 Sep 1987).

Complete active space MCSCF followed by MRSDCI (multireference singles and doubles configuration interaction) calculations are carried out on the electronic states of PtH_2. Spin—orbit interaction is introduced using a relativistic configuration interaction scheme on PtH^+ whose d orbital Mulliken population is close to that of the d population of PtH_2 and thus enables calculation of spin—orbit splittings for the electronic states of PtH_2. The bending potential energy surfaces of the $^1A_1$ and $^3A_1$ states are obtained. The $^1A_1$ surface has a bent minimum and dissociates almost without a barrier into $Pt(^1S_0)$ and H_2, while the $^3A_1$ state has a large (—55 kcal/mol) barrier to dissociation into $Pt(^3D_3)+H_2$. The ground state of PtH_2 is a bent $^1A_1$ state ($\theta = 85^o$).

39889 **Reply to the "Comment on 'The relationship between shape resonances and bond lengths' ".** Piancastelli, M.N.; Lindle, D.W.; Ferrett, T.A.; Shirley, D.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 5, 3255-3256(1 Sep 1987). Contract AC03-76SF00098.

The relationship between shape-resonance energies and bond lengths within agiven molecule is explored further.It is contended that some shape-resonance assignments presented by Stohr and Hitchcock (ref.1) are not convincing.(AIP)

39890 **Saddle-point electrons in ionizing ion-atom collisions.** Olson, R.E.; Gay, T.J.; Berry, H.G.; Hale, E.B.; Irby, V.D. (Laboratory for Atomic & Molecular Research and Physics Department, University of MissouriRolla, Rolla, Missouri 65401). *Physical Review Letters;* **59**: No. 1, 36-39(6 Jul 1987).

We have studied $H^+ + He$ ionizing collisions, and find that electrons stranded between the two postcollision Coulomb centers dominate the ejected-electron spectra for intermediate (—100 keV) projectile energies. The importance of these electrons is clearly established by our classical calculations which are in qualitative agreement, in both shape and magnitude, with experimental spectra taken by us, and with earlier measurements. These "saddle-point" electrons are produced by a classically understandable mechanism, and are unambiguously observed at nonzero scattering angles.

39891 **Beam-chopper development at LAMPF.** Hutson, R.L.; Cooke, D.W.; Heffner, R.H.; Schillaci, M.E.; Dodds, S.A.; Gist, G.A. (Los Alamos National Lab., NM; Rice Univ., Houston, TX). *Hyperfine Interactions;* **32**: No. 1-4, 893-900(Dec 1986). (CONF-8606134—).

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (1 Jun 1986).

Also published as report LA-UR—86-2167; CONF—8606134-4.

In order to reduce pileup limitations on μSR data rates, a fast chopper for surface muon beams was built and tested at LAMPF. The system allowed one muon at a time to be stopped in a μSR sample in the following way: a surface beam from the LAMPF Stopped Muon Channel was focused through a crossed-field beam separator and onto a chopper slit. With the separator E and B fields adjusted properly, the beam could pass through the slit. The beam to the μSR sample was turned on or off (chopped) rapidly by switching the high voltage applied to the separator plates on or off within approximately 500 ns; with the E field off, the B field deflected the beam, dumping it near the slit. We demonstrated that, with improved electronics, we will be able to stop a single muon in a μSR sample as frequently as once every 20 μs and that data rates for the system can be a factor of five higher than is attainable with unchopped beams. The observed positron contamination of the beam was less than 5%, and the ratio of the muon rate with beam on to the rate with beam off was 1540.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 39345

39892 **(AD-A—179884/2/XAB) Basic processes of plasma propulsion. Scientific report (Final), August 1 1982-31 July 1986.** Schrade, H.O.; Auweter-Kurtz, M.; Kurtz, H.L. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Raumfahrtsysteme). 30 Jan 1987. 112p. NTIS, PC A06/MF A01.

The current density distribution, flow, pressure, and density fields are calculated for a (quasi-) steady nozzle-type MPD thruster, based on a partially two-dimensional approach, assuming a fully singly ionized plasma with an isothermal electron and an adiabatic ion behavior. In addition, for a given current rise, the current contour lines and the flow, pressure, and density fields within the cylindrical flow-discharge region are calculated as a function of time. II. In order to investigate the arc stability, a unique theoretical approach is presented which allows determination of the stability behavior of an arbitrarily shaped current-carrying plasma channel under various conditions. Based on this novel theory, the onset phenomenon observed in any nozzle-type MPD arc jets can be predicted; calculated any measured results agree favorably. III. The cathode attachment of electric arcs are theoretically and experimentally investigated. The erosion effects and the surface damage due to spots are discussed; they stem from evaporation, droplet ejection, and/or splashing. The most severe damage to the cathode surface occurs when many small spots cluster together and build one or even several larger spots which now cause melting and splashing.

39893 **(LA-UR—87-1548) Final state effects in neutron scattering experiments on momentum distributions in quantum fluids.** Silver, R.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 3p. (CONF-870873—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010109.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

Using a "hard core perturbation theory," the final state corrections to the impulse approximation are derived for high Q neutron scattering experiments to determine momentum distributions in quantum fluids. The final state broadening depends on the radial distribution function, g(r), and the He-He phase shifts. It has a zero second moment and no Lorentzian wings, satisfying the kinetic energy sum rule. Explicit results are presented for superfluid ^{4}He.

39894 **(UCRL—96434) Computer simulation of nonequilibrium processes.** Hoover, W.G.; Moran, B.; Holian, B.L.; Posch, H.A.; Bestiale, S. (Los Alamos National Lab., NM (USA); Vienna Univ. (Austria). Inst. fuer Experimentalphysik; Institute for Advanced Studies, Palermo (Italy)). 1987. Contract W-7405-ENG-48. 4p. (CONF-870753—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011325.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Recent atomistic simulations of irreversible macroscopic hydrodynamic flows are illustrated. An extension of Nose's reversible atomistic mechanics makes it possible to simulate such non-equilibrium systems with completely reversible equations of motion. The new techniques show that macroscopic irreversibility is a natural inevitable consequence of time-reversible Lyapunov-unstable microscopic equations of motion.

39895 **Kozeny—Carman relations and image processing methods for estimating Darcy's constant.** Berryman, J.G.; Blair, S.C. (Lawrence Livermore National Laboratory, P. O. Box 808 L-156, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 6, 2221-2228(15 Sep 1987).

A natural connection is demonstrated between Kozeny—Carman relations for porous media and the image processing techniques which have recently been applied to the problem of estimating the parameters in such relations. It is shown that the term in the Kozeny—Carman relation related to the specific surface area is best estimated from a smoothed version of the actual material surface. To measure this image specific surface, the magnification of a cross section of the porous material should be chosen so that a typical correlation length for the sample corresponds to a distance comparable to 100 discrete picture elements. Under these conditions, the assumptions typically made in the derivation of a Kozeny—Carman relation are entirely compatible with the resolution constraints imposed by digitizing the image. Thus, although the measured image specific surface may be considerably smaller in magnitude than the true specific surface area of the material (due to resolution constraints), this smaller value is nevertheless the required input to the Kozeny—Carman relation. The argument is based on a known comparison theorem relating the permeabilities of two porous materials which differ only by the addition (without rearrangement) of the solid to the more porous material.

39896 **Phases of helium adsorbed on graphite: A Feynman path-integral Monte Carlo study.** Abraham, F.F.; Broughton, J.Q. (IBM Almaden Research Center, K33/801 650 Harry Road, San Jose, California 95120-6099). *Physical Review Letters;* **59**: No. 1, 64-67(6 Jul 1987).

The phases of ^{3}He adsorbed on graphite are simulated by use of the Feynman path-integral Monte Carlo method. The fluid, commensurate solid, incommensurate solid, and reentrant fluid phases are found and are in agreement with the experimental phase diagram. The microscopic structure of the reentrant fluid is observed to be a striped domain-wall liquid and is consistent with a recent experimental interpretation and theoretical model. Larger-size systems are required for further quantitative analysis of the domain-wall liquid.

39897 **Some aspects of the wetting transition.** Percus, J.K. (Courant Institute of Mathematical Sciences and Physics Department, New York University, New York, New York 10012). *Journal of Statistical Physics;* **47**: No. 3, 801-826(Jun 1987).

The wetting of an attractive planar wall by liquid at liquid-gas coexistence is investigated from a microscopic point of view. A model for interface detachment due to thermal fluctuations is first worked out. An empirical framework for distinguishing between first-order and continuous wetting transitions is then set up, and quantified by the introduction of the van der Waals mean field model. This is solved for strong, short-range and weak, long-range forces. The role of fluctuations is reconsidered, and the nature of the required corrections examined, both for wall-fluid and fluid-fluid interfaces.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 39998

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 39526, 39527, 39542, 39870, 39958, 39959, 39960, 39963, 39965, 39966

39898 (DESY—86-009) Radiative decays in the psi family. Koenigsmann, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Wuerzburg Univ. (Germany, F.R.)). Jan 1986. 67p. NTIS, PC E09; Available from NTIS as TIB/B87-06446.

This report presents a summary on radiative decays of the psi states. Most of the experimental information has been obtained by the experiments DM 2, Mark III and Crystal Ball operating at the storage rings DCI and SPEAR. Radiative decays from the psi' yield an abundance of information on the C-parity even states within the charmonium system. Nearly all experimental data on CHI and eta/sub c/ mesons compare favourably with theoretical predictions. Overall, an impressive agreement emerges between charmonium spectroscopy and theoretical models. Radiative transitions from J/psi to light mesons have helped to better understand the low lying nonets. Two unexpected resonances, the iota(1460) and Θ(1700), have large production rates and exhibit unusual decay properties. The Θ is almost certainly a non-qanti q state and qualifies as a gluonic meson candidate. The iota is more controversial. A classification will have to depend on a detailed understanding of the excited pseudoscalar nonet. Finally, evidence for the zeta(2200) will be reported and its interpretation will be reviewed.

39899 (DESY—86-014) Exclusive hadron production in two photon reactions. Poppe, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). Feb 1986. 114p. NTIS, PC E11; Available from NTIS as TIB/B87-06378.

This paper summarises experimental results on exclusive hadron production in two photon collisions at electron positron storage rings and attempts some interpretation. Experimental know how is described and new suggestions are made for future analyses. New model calculations on resonance form factors and pair production amplitudes are presented. The two photon vertex is decomposed such that experiments can be parameterised with the minimal number of free parameters. Selection rules for off shell photon collisions are given in addition to Yang's theorems.

39900 (DOE/ER/40150—31) Experimental aspects of hypernuclear physics at CEBAF [Continuous Electron Beam Accelerator Facility]. Mecking, B.A. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 26p. (CEBAF-R—86-013). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012468.

The general features of the electromagnetic excitation of hypernuclei are outlined. Experimental aspects of investigating these reactions at CEBAF are discussed. Two specific experimental setups are compared. 17 refs., 6 figs.

39901 (INIS-mf—10911, pp 46) Recent results from UA2. Tovey, S.N. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39902 (INIS-mf—10911, pp 94) University of Sydney underground physics program. Peak, L.S.; Bakich, A.M. (Sydney Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39903 (KFK—4211) Search for unstable photinos. Mayer, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Apr 1987. 106p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10185.

We have searched in e/sup +/e/sup -/-annihilation for the photino, the partner of the photon, which is predicted by supersymmetry. Photinos can be pair produced in e/sup +/e/sup -/ annihilation by the exchange of a scalar electron, the partner of the electron. It was assumed that the photino is unstable and decays in a photon and a lighter supersymmetric particle. This second particle leaves the detector unobserved. In the final state one sees then two photons with missing energy and missing momentum. The data were taken with the detector CELLO at the e/sup +/e/sup -/ storage ring PETRA at DESY, Hamburg. The CMS energy was between 38.3 GeV and 46.8 GeV, the total luminosity was 38.3 pb/sup -1/. The liquid argon lead calorimeter of CELLO, the most important part for this analysis, is specialised for the measurement of electromagnetic showers. It has a good space resolution and covers 96% of the solid angle of 4π. We have selected events with 2 photons in the central calorimeter, both with an energy of more than 2 GeV. The high background due to cosmic showers was reduced by accepting only events which were correlated to the time of the e/sup +/e/sup -/ annihilation. Also the direction of the showers had to point to the interaction point. The applied cuts accepted the expected events with a probability P≈0.3. No event was found which was compatible with the production of unstable photinos. One can give limits on the mass of the photino, which depend on the mass of the scalar electron and on the decay path of the photino. In the simplest case, if all photinos decay at the interaction point, photinos with masses below 21 GeV are excluded (with a mass of the scalar electron below 40 GeV).

39904 (LA-UR—87-2126) Parity nonconservation in proton scattering at higher energies. Mischke, R.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-8705158—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011746.

From Symposium on parity non-conservation; Vancouver, UK (28 May 1987).

Parity-nonconservation experiments in the scattering of longitudinally-polarized protons at incident proton momenta of 1.5 GeV/c and 6 GeV/c are examined. These experiments indicate a change with energy of the total cross section correlated with proton helicity that was unexpected. This energy dependence is due to the strong part of the interaction and may indicate the role of a diquark component in the nucleon. New experiments at higher energies are needed to confirm such a model. Future experiments can benefit from an analysis of sources of systematic error that have been encountered in the experiments discussed here. 43 refs., 3 figs.

39905 (LBL—23469) Is Dark Matter made out of particles? Current searches and detector developments. Sadoulet, B. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 9p. (CONF-870164—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012885.

From 7. Moriond workshop: searches for new and exotic phenomena; Les Arcs, France (24 Jan 1987).

The hypothesis that Dark Matter is made out of exotic particles is definite enough to be testable in a variety of ways. We review the first generation experiments looking for dark matter particles, using conventional techniques. They may find those particles and in any case will provide powerful constraints. We argue that in the long run, cryogenic detectors will have to be used for that type of physics, and since the European effort is covered by other speakers, we review the present developments in this area in the USA. 18 refs., 1 fig.

39906 (SLAC—312, pp 495-506) D/sub s/ production data from Mark III. Toki, W. Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—). Contract AC02-76ER01195;AC03-81ER40050.

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Preliminary results on D/sub s/ decays from the Mark III at SPEAR are presented. The data were taken at a e^+e^- center of mass energy of $\sqrt{s}$ = 4.14 GeV with a total integrated luminosity

of 6.3 +/- 0.46 pb. The decay $e^+e^- \rightarrow$ D/sub s/D/sub s/*, D/sub s/ $\rightarrow$ phi π is observed, yielding a D/sub s/ mass of 1973 +/- 4 +/- 4 MeV/c^2 and a D/sub s/* mass of 2110.8 +/- 1.9 +/- 3.2 MeV/c^2 with a rate of $\sigma(e^+e^- \rightarrow$ D/sub s//sup +/-/D/sub s//sup +/-/*, D/sub s//sup +/-/* $\rightarrow \gamma$D/sub s//sup +/-/) x B(D/sub s/$^+ \rightarrow$ phi π/sup =/-/) = 36 +/- 7 +/- 13 pb. There is evidence for two other modes, D/sub s//sup +/-/ $\rightarrow$ K^0* K/sup +/-/ and D/sub s//sup +/-/ $\rightarrow$ K/sub s/^{0}K/sup +/-/, which are observed with rates of $\sigma(e^+e^- \rightarrow$ D/sub s/D/sub s/*) x B(D/sub s/$^+ \rightarrow$ K^0*K/sup +/-/) = 31 +/- 6 +/- 11 pb and $\sigma(e^+e^- \rightarrow$ D/sub s/ D/sub s/*) x B(D/sub s//sup +/-/ $\rightarrow$ K/sub s/^{0}K/sup +/-) = 16 +/- 3 +/- 5 pb. This paper presents preliminary results on D/sub s/ and D/sub s/* decays from the Mark III experiment at SPEAR. The data were taken in spring 1986 at a center mass energy of $\sqrt{s}$ = 4.14 GeV/c^2. This paper is divided into five sections. The first is an introduction that briefly reviews the expected D/sub s/ decay modes, the D/sub s/* - D/sub s/ mass difference and the expected D/sub s production rate. The next three sections discuss separately the analyses on the three modes, D/sub s//sup +/- $\rightarrow$ phi π/sup +/-, D/sub s//sup +/-/ $\rightarrow$ K^0* K/sup +/- and D/sub s//sup +/-/ $\rightarrow$ K/sub s/^{0}K/sup +/- produced from $e^+e^- \rightarrow$ D/sub s/D/sub s/*. The last section summarizes the results.

39907 **(WU-D—86-10) Study of the electron contribution in deep inelastic events measured in the spectrometer of the European Muon Collaboration. Study on the exclusive production of rho/sup 0/ and phi mesons in the deep inelastic muon scattering.** Moenig, K. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 8 - Naturwissenschaften 1 - Physik). Jun 1986. 65p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-06301.

This report deals with data of the EMC from 1984. In the first part the electron background in hadron spectra was studied by means of the calorimeter H2 and compared with a Monte Carlo simulation. Because of the beam hole in the center of H2 the electron contribution at high relative hadron energies can be determined only insufficiently. If however tracks passing this hole are excluded the results from the measurement and the simulation calculation agree within the errors. Therefore it can be assumed that the Monte Carlo describes the electrons in the whole range sufficiently and is therefore suited for the correction of the spectra. In the second part of the report the exclusive production of rho/sup 0/ and phi mesons was considered. The growth parameter for the t distributions of the rho was proved as small and dependent on the momentum transfer Q/sup 2/ consistently with older EMC measurements on hydrogen. The contribution of coherent scattering was essentially smaller than measured in real photoproduction and decreased also with Q/sup 2/. The ratio of the cross sections σ/sub rho/ : σ/sub phi/ was determined to 9:(1.6 +- 0.4). The deviation from measurements with real photons (9:0.6) can be understood if for Q/sup 2/ -> proportional to the SU(3) prediction 9:2 is taken and it is assumed that the Q/sup 2/ dependence of the cross sections is given by the propagator.

39908 **Using the decay-in-flight source at line-E of LAMPF.** Clearwater, S. (Univ. of California, Los Angeles, Los Angeles, CA 90024). pp 363-371 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

This paper describes an experiment to measure the ν/sub μ/ C/sup 12/ $\rightarrow \mu$/sup -/X cross section and to detect ν/sub μ/$\rightarrow \nu$/sub e/ oscillations. A test run was completed last year. The detector has been calibrated and backgrounds are under study. The sensitivity of the experiment is estimated for the 1985 LAMPF run cycle to be +- 20% for the cross section measurement and the 90% confidence level limits for the neutrino oscillation experiment are sin/sup 2/2θ<10/sup -3/ and Δm/sup 2/<10/sup -1/eV/sup 2/.

39909 **A search for neutrino oscillations at the Brookhaven AGS.** Ahrens, L.A.; Aronson, S.H.; Connolly, P.L.; Gibbard, B.G.; Murtagh, M.J.; Murtagh, S.J.; Terada, S.; White, D.H. (Brookhaven National Lab., Upton, NY 11973). pp 344-354 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

The authors report on a search for neutrino oscillations of the type ν/sub μ/ $\rightarrow \nu$/sub e/ in a detector located an effective distance of 96m from the neutrino source in the wide band neutrino beam at the Brookhaven AGS. No excess of electron events was observed. The resulting upper limit on the strength of the mixing between ν/sub μ/ and ν/sub e/ in the case of large mass difference Δm/sup 2/ = vertical barm/sub 1//sup 2/ - m/sub 2//sup 2/vertical bar between the neutrino mass eigenstates m/sub 1/ and m/sub 2/ is sin/sup 2/2$\alpha \leqq$ 3.4 x 10/sup -3/ at 90% CL. The corresponding upper limit for small mass difference is Δm/sup 2/ sin2α < 0.43 eV/sup 2/.

39910 **Neutrino mass limit from rare Kaon decays.** Eilam, G. (Institute of Theoretical Science, Univ. of Oregon, Eugene, OR 97403). pp 255-265 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

The present limit on the mass of the tau neutrino (m/sub ν// sub tau/ <143 meV) obtained from tau decay, may be lowered significantly from a study of the pion spectrum in K/sup +/ $\rightarrow$n/sup +/$\nu\nu$-bar. The author shows that if m/sub ν//sub tau/ > 50 MeV then the pion spectrum differs significantly from its value when all neutrinos are massless. Our results are also applicable to any new massive neutrino with 50 $\leqq$ m/sub ν//sub h/ $\leqq$ 150 MeV.

39911 **Heavy neutrinos and new bosons at the SSC.** Kayser, B.; Deshpande, N.; Gunion, J.F. (Div. of Physics, National Science Foundation, Washington, DC 20550). pp 221-254 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Methods for seeking and studying heavy neutrinos and new W bosons at the SSC are considered. Such particles are predicted by left-right symmetric models. Their properties and experimental signatures are analyzed.

39912 **Speculations on neutrino masses and mixings.** Pakvasa, S. (Dept. of Physics and Astronomy, Univ. of Hawaii at Manoa, Honolulu, HI 96822). pp 213-220 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Several scenarios for the pattern of neutrino masses and mixings are described. As in all discussions of fermion masses and mixings the audience should be warned beforehand: "Caveat Emptor." which may be interpreted (in addition to "Buyer Beware") as a warning that what follows should be taken with a grain of salt but on the other hand should it also turn out to contain a grain of truth you will be reminded where you heard it. The reason for this is simply the fact that we do not yet possess a theory of fermion masses despite any claims you may hear to the contrary. In this talk the author outlines several possible scenarios for the pattern of neutrino masses and mixings which can be experimentally tested and ruled out. Some of these are based on the S/sub 4/ permutation symmetry model discussed here.

39913 **Geophysical neutrino oscillation searches.** Gaisser, T.K. (Physics Dept., Univ. of Wisconsin, Madison, WI 53706). pp 204-212 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

In this talk the author reviews the subject of searching for neutrino oscillations with underground detectors. As pointed out by Ramana-Murthy, effects of propagation in matter can significantly reduce the sensitivity of these experiments. Illustrations are given for a variety of mixing angles, taking into account a realistic distribution of neutrino energies and decay paths.

39914 **Prospects for observing K/sup +/ $\rightarrow \pi$/sup +/ $\nu\nu$-bar.** Atiya, M.S. (Brookhaven National Lab., Upton, NY 11973). pp 11-19 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985). Contract AC02-76CH00016.

The authors report on the progress of experiment 787 at Brookhaven National Laboratory designed to study K/sup +/ $\rightarrow$ π/sup +/ + '....' where '....' is a one or more feebley interacting

neutrals. The experiment will have an initial sensitivity of 2 x 10/ sup -10/ for two or more particles(e.g. K/sup +/ → π/sup +/νν-bar), and 4 x 10/sup -11/ for one particle(e.g. K/sup +/→π/sup +/ + axion). The experiment can also study such reactions as K/ sup +/ → π/sup +/γγ ,K/sup +/ → π/sup +/ μ/sup +-/e/sup -+/, K/sup +/ → μ/sup +/νγ, π/sup 0/ → νν-bar, and π/sup 0/ → e/sup +/e/sup -/.

39915 **Physics with linear colliders in the tev CM energy region.** Bulos, F.; Cook, V.; Hinchliffe, I.; Lane, K.; Pellet, D.; Perl, M.; Seiden, A.; Wiedemann, H. (Stanford Linear Accelerator Center, Stanford, CA 94305). pp 71-81 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

It may well be that the e/sup +/e/sup -/ physics beyond PEP and PETRA and up to 200 GeV CM energy will deal primarily with the verification of the standard model (SM) of weak and electromagnetic interactions. Various theoretical and experimental studies at workshops for contemplated accelerators (SLC, LEP I, Z^0) have assumed this. Beyond 200 GeV the picture is less clear. The absence of theoretical models with strong predictions comparable to the SM adds to the difficulty. In addition, the experimental verification of the SM itself is yet to come, and one is forced to make certain assumptions about the outcome. The following assumptions are made: Z^0, W/sup +-/, light higgs (if M/sub H/ < 100 GeV) have all been discovered. The t quark has been discovered if its mass is < 100 GeV. QCD is basically the correct theory of the strong interactions. With these assumptions, the authors have produced an updated table of possible physics in the TeV region. This table was used as the basis for the study of specific physics. It contains best estimates of cross-section, promising signatures for final states, and some helpful comments.

39916 **General features of 1-TeV physics.** Peskin, M.E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 209-210 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Both the energies of the new machines being discussed and the details of the theoretical proposals under study look toward new interactions at an energy of roughly 1 TeV. This energy certainly expresses the frontier of our ignorance: it represents the limits of the ability of proposed accelerators to view new physics, and it represents as well the boundary of applicability of the theoretical synthesis represented by the standard model. But the energy region of 1 TeV is also the place where our current understanding of physics compels us to look for new phenomena, there place where something should happen that will shape the next development of fundamental physics. In this short contribution, the author summarizes the most important predictions for physics in this energy region, and to stress their relative model independence. He has been impressed by the diversity of theoretical proposals for new physics at this scale; but perhaps even more strongly, he has been impressed that these diverse proposals lead to observable phenomena accessible to the new accelerators which are, at a qualitative level, remarkably similar. He intends to indicate why this is so, and to argue that the effects these theories hold in common should be searched for diligently, since they are more likely than any specific theories to be true aspects of nature.

39917 **Reasons experiments can be performed at a pp machine at L = 10/sup 33/cm/sup -2/sec/sup -1/.** Gordon, H.A.; Ludlam, T.; Platner, E.; Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY 11973). pp 357-360 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Examples of experiments that cope with high rate environments are given. Then the factors which lead to the conclusion that experiments can be performed at L = 10/sup 33/cm/sup -2/sec/ sup -1/ in pp collisions at $\sqrt{s}$ = 800 GeV are discussed.

39918 **Low and medium (— 30 GeV/c) P/sub t/ physics at ISABELLE.** Lindenbaum, S.J. (Brookhaven National Lab.). pp 524-526 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016;AC02-79ER10550.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The author discusses some Forward Angle Physics that can ONLY be done at ISABELLE. He considers p-p Total Cross Section; real Part of the p-p Elastic Forward Scattering Amplitude; and p-p Differential Elastic Scattering Cross Section. ISABELLE allows one to probe higher t than the p-p equivalent in the CERN and Fermilab colliders. For example, the first dip in elastic scattering should be seen with the p bar-p colliders as well as at ISABELLE, and this may be possible for a second dip. However, ISABELLE's luminosity is required to study elastic scattering more thoroughly. The dip-bump structure in the elastic scattering should be measureable with luminosities of a few times 10/sup 30/, however for t > 5 GeV, one would need L > 10/sup 31/cm/sup -2/sec/ sup -1/.

39919 **Fermilab and the future of hep.** Lederman, L.M. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 125-127 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The author considers how to break out of the aging lab and inadequate lab site constraints - how to creatively leapfrog the world and get to the multi TeV domain soon. The possibility of near-term (less than →4 years) technological breakthroughs seems very remote. His experiences with SAVER magnets and the complexities of 10 tesla magnets indicates that here, again, one is faced with a long R and D program, with no assurance that it will break through on costs. One is then led to consider old technology: iron magnets and with radical innovations in fabrication, mass production, installation, etc., so as to bring the costs per meter down substantially more than the ratio of magnetic fields. Since the operating costs are also relevant, the iron would have to be energized by superconductors; i.e., one is talking about an old idea, superferric magnets. Since state-of-the-art systems are being used, it seemed plausible that a 1-2 year R and D program could yield a very good assessment of the possibilities. Now, with 2-3 tesla magnets, a very large site - clearly a new laboratory would become the U.S. High Energy Lab. It would have to contain a ring of — 15-30 Km radius, and if shallow trenching (instead of conventional tunnels) is the mode, then the site must be very flat, sparsely populated, yet near a good, international airport. Hence the accolade, "Machine-in-the-desert."

39920 **On physics with a high-intensity proton accelerator below 30 GeV.** Hoffman, C.M. (Los Alamos National Lab., Los Alamos, NM 87545). pp 567-568 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The types of physics that would be pursued at a high-intensity, moderate-energy proton accelerator are discussed. The discussion is drawn from the deliberations of the 30-GeV subgroup of the Fixed-Target Group at this workshop.

39921 Future search for grand unified theory magnetic monopoles. Ayres, D.; Cline, D.; Heller, K.; Marciano, W.; Shrock, R. (Argonne National Lab., Argonne, IL 60439). pp 603-621 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

After a brief discussion of the theoretical notation, the authors discuss the present experimental limits and experimental techniques in the search for very massive magnetic monopoles. They attempt to survey possible future experiments and the limits of the experimental techniques with emphasis on the type of R and D that are useful in these searches.

39922 Prospects for particle physics and astrophysics with cosmic rays. Gaisser, T.K.; Jones, L.W. (Bartol Research Foundation of the Franklin Institute, Univ. of Delaware, Newark, DE 19711). pp 636-640 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The field of high energy cosmic rays forms a bridge between high energy physics and astrophysics. In this paper the authors review the present status of the field and plans for new experiments, expecially those in the U.S. They expect significant further progress from the study of small air showers in the 10/sup 15/-10/sup 16/eV range when such indirect experiments have been calibrated by direct measurement of the primary cosmic ray composition to —10/sup 14/ eV and by collider experiments around $\sqrt{s}$ — 1 TeV. At higher energies we expect progress to focus on the Fly's Eye experiment at Utah and possible new related experiments. Such experiments explore energies up to —10/sup 20/ eV or $\sqrt{s}$ >100 TeV. Searches for cosmic ray antimatter, studies of nucleus-nucleus collisions around 100 GeV/nucleon and studies of cosmic ray neutrinos may also yield results of great interest for high energy physics and astrophysics.

39923 Hadron hadron collider group. Palmer, R.; Peoples, J.; Ankenbrandt, C.; Baltay, C.; Diebold, R.; Eichten, E.; Gordon, H.; Grannis, P.; Lanou, R.; Leveille, J. (Brookhaven National Lab., Upton, NY 11973). pp 90-97 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The objective of this group was to make a rough assessment of the characteristics of a hadron-hadron collider which could make it possible to study the 1 TeV mass scale. Since there is very little theoretical guidance for the type of experimental measurements which could illuminate this mass scale, the authors chose to extend the types of experiments which have been done at the ISR, and which are in progress at the SPS collider to these higher energies. Initially they chose to call these experiments "bellwether experiments" for reasons of convenience. In the absence of any alternative predictions they assumed that the cross sections for these standard experiments could be obtained either by extrapolating perturbative QCD models of hadrons to center of mass energies of 40 TeV or by extrapolating phenomenological parameterization of data obtained from experiments done in the center of mass energy range of 20 to 60 GeV to 40 TeV. For each bellwether they asked up to what mass (or momentum transfer Q) could a significant (≧ 100) number of events be seen in 10/sup 7/ seconds. While it is unlikely that these bellwethers will be among the definitive experiments in the 1 TeV mass scale, some of them represent the background which will obscure new phenomena. It was their view that the new collider should have sufficient luminosity and energy so that at least some of these experiments could be done.

39924 Using K/sup +/ decays as a source of tagged π/sup 0/'s. Hoffman, C.M. (Los Alamos National Lab., Los Alamos, NM 87545). pp 572-573 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The rare decays π/sup 0/ → e/sup +/e/sup -/ π/sup 0/ → ν ν-bar, and π/sup 0/ → /sup —/γ/sup —/γ are discussed. Better measurements are called for because the physics interests in these decays are high. The process K/sup +/ → π/sup +/π/sup 0/ provides an appropriate source of tagged π/sup 0/'s in vacuum for these measurements. Experimental possibilities are examined. It appears that using K/sup +-/ → π/sup +/π/sup 0/ is a useful source of tagged π/sup 0/'s to investigate the rare decays π/sup 0/ → e/sup +/e/sup -/, π/sup 0/ → /sup —/γ/sup —/γ, and π/sup 0/ → ν ν-bar. Present accelerator intensities may be sufficient to study the first process, although a detailed experimental design may show that higher intensities are needed. Higher flux beams clearly are needed to achieve the best sensitivity to π/sup 0/ → ν ν-bar and π/sup 0/ → /sup —/γ/sup —/γ.

39925 Measurement of ν and νe elastic scattering as a test of the standard model. Abe, K.; Taylor, F.E.; White, D.H. (Univ. of Pennsylvania, Philadelphia, PA 19104). pp 165-174 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Various tests of standard SU XU model of weak interactions which can be performed by measurements of electron and muon neutrino-electron elastic scattering are reviewed. Electron neutrino-electron elastic scattering has both a neutral current part as well as a charged current part, and therefore offers a unique place to measure the interference of these two amplitudes. A measurement of the y-dependence of neutrino-electron elastic scattering can separately measure g/sub V/ and g/sub A/ as well as test for the presence of S, P, or T terms. Several measurable quantities involving cross sections and the interference term are derived from the standard model. Various design considerations for an experiment to determine the NC-CC interference term and the y-dependence of muon neutrino-electron elastic scattering are discussed.

39926 Testing the compositeness of quarks and leptons. Abolins, M.; Blumenfeld, B.; Eichten, E.; Kagan, H.; Lane, K.; Leveille, J.; Pellett, D.; Peskin, M.; Wiss, J. (Michigan State Univ., East Lansing, MI 48824). pp 274-287 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

One of the major currents of physics in the twentieth century has been the unfolding of structure, the successive analysis of atoms, nuclei, and nucleons into constituent particles with more fundamental equations of motion. It is, then, natural to ask whether quarks and leptons can also be decomposed into simpler constituents. At one time, this idea could be viewed as a casual speculation. But in the past few years, the proliferation of quarks and leptons has become one of the central puzzles of particle physics, and the problem of computing the mass spectrum of quark and leptons has become one of its most difficult challenges. Models in which quarks and leptons are composite have provided a major approach to the resolution of these questions. It is thus important to search for experimental signs of the composite nature of quarks and leptons. In this paper, the authors compare the abilities of various proposed accelerators to probe for indications of this structure.

39927 An e-p primer. White, D.H. (Brookhaven National Lab., Upton, NY). pp 441-447 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

In reviewing the extensive literature, it became clear that simple-minded relations that allowed comparison between options were not available. Each report has concentrated on a specific combination of electron and proton energies. The author has tried, therefore, to generate rules of thumb which will allow comparisons of options which may be considered in the future. He attempts, therefore, to make available some appropriate simplifications which may allow others to reach their own judgments on the merits of various combinations. He discusses the kinematics, which tend to be rather different from those at fixed target machines and symmetric colliders. He makes use of invariants whenever possible, with an attempt to make clear their effect in a laboratory situation. The author has selected three invariants as the prime choice to describe the scattering processes s (the c.m. energy squared), Q/sup 2/ (the negative four-momentum transfer squared to the electron), and x, the fraction of the target momentum carried by the struck parton. He makes corrections to the other frequently used variables y, ν and W, the c.m. energy of the photon (boson), proton system.

39928 Prospects in lepton-flavor violation. Hoffman, C.M. (Los Alamos National Lab., Los Alamos, NM 87545). pp 527-530 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The theoretical and experimental situation regarding lepton-flavor conservation is reviewed and upcoming experiments are described. It is concluded that future improvements in experimental sensitivities will require higher flux, higher quality muon and kaon beams.

39929 Rare K-decay experiments. Bunce, G. (Brookhaven National Lab., Upton, NY 11973). pp 537 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The present proposals for searching for rare K decays, at a level of 10/sup -11/, are still a factor of 10 under the present available AGS intensity. It seems possible to, eventually, use that factor of 10 after the experience of the present experiments. New ideas, which, typically, are likely, would be required to make use of another factor of 10 if the AGS intensity were increased. A more fundamental limit on rare K-decay branching ratios may be background which, as calculated for E777, comes in at a level of 3 x 10/sup -12/ for K/sup +/ $\rightarrow$ π/sup +/π/sup +/π/sup -/, with π/sup +/ $\rightarrow$ μ/sup +/ν, and the π/sup -/ misidentified as an electron. The experiments are particularly suited for the AGS energy range because they require excellent particle identification.

39930 A conceptual design for A K/sub OL/ tagged neutrino beam. Nodulman, L. (Argonne National Lab., Argonne, IL 60439). pp 574-575 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

A neutral channel at a 20-TeV fixed-target proton accelerator could be used to provide a tagged neutrino beam using K/sub 0L/ decays. Muon and electron neutrinos and antineutrinos are identified and energy tagged up to above 2 TeV, allowing excellent systematics and good statistics in studying their interactions. The precise measurement of cross sections for charged-current and neutral-current interactions provide an excellent check for deviations from the standard model of electroweak interactions. Without the benefit of detailed Monte-Carlo studies needed for a specific proposal, we show a conceptual design demonstrating the feasibility of such a program.

39931 Neutrino oscillation search with cosmic ray neutrinos. Ayres, D.S.; Gaisser, T.K.; Mann, A.K.; Shrock, R.E. (Argonne National Lab., Argonne, IL 60439). pp 590-599 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

It is shown that a sensitive search for neutrino oscillations involving more flavors than just ν/sub e/ and ν/sub μ/ is provided by measurement of the ratio of the total interaction rates of upward- and downward-going cosmic ray neutrinos within a massive (—10 kiloton) detector. Assuming mixing between all pairs of ν/sub e/, ν/sub μ/ and ν/sub tau/, the experiment is capable of observing time averaged probabilities <P/sub e tau/>/sub t/ and <P/sub μtau/>/sub t/ of magnitude set by mixing strengths corresponding to, e.g., the d- to s-quark mixing strength, and of reaching the limit Δm/sub ij//sup 2/ identical to the absolute value of m/sub i//sup 2/-m/sub j//sup 2/ $\approx$ 10/sup -4/ eV/sup 2/, where m/sub i/, m/sub j/ are neutrino mass eigenstates, and P/sub e tau/ and P/sub μ tau/ are the probabilities for ν/sub e/ and ν/sub μ/, respectively, to oscillate into ν/sub tau/ after traversing a distance L $\approx$ diameter of the earth.

39932 Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). 1-17p. (CONF-8206116—). National Science Foundation, 1800 G Street NW, Washington, DC 20550.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The authors summarize the results of the standard model group which has studied the ways in which different facilities may be used to test in detail what is now called the standard model, that is SU/sub c/ x SU x U.

39933 Heavy quark jets. Chau, L.L.; Ludlam, T.; Paige, F.E.; Platner, E.D.; Protopopescu, S.D.; Renak, P. (Brookhaven National Lab., Upton, NY 11973). pp 510-520 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The authors have shown that it is possible in principle to design a detector of modest dimensions capable of detecting heavy quark jets with good rejection of light quark (and gluon) jets. In order to achieve this, good lepton identification and the ability to tag a charmed particle decay with a high resolution vertex detector are indispensible. To keep the vertex detector within realistic dimensions the authors make use of the possibility at ISABELLE of a small interaction diamond (+- 2 cm full width) with high luminosity, L=10/sup 32/ cm/sup -2/ sec/sup -1/. With two detectors placed opposite to each other it is possible to collect at least 2 x 10/sup 5/ unbiased heavy quark jets (in the detector opposite the tagged jet) in a year of running with practically no background from other processes. More sophisticated on-line data processing could raise this number to 2 x 10/sup 6/. The ratio of c to b jets in this sample is 2 to 1. With such large numbers of B mesons it is conceivable that some decay modes may be fully reconstructed. Of particular interest is the decay B/sup +-/ $\rightarrow$ K/sup +-/e/sup +/ e/sup -/ for which an upper limit of 10/sup -5/ is achievable, easily an order of magnitude better than what is possible at LEP. The standard model predicts 10/sup -6/ for this branching ratio; however, horizontal gauge symmetries can increase it to 10/sup -4/ which would be observable with the detectors envisaged here.

39934 Prospects for future experiments to search for nucleon decay. Ayres, D.S.; Heller, K.; Lo Secco, J.; Mann, A.K.; Marciano, W.; Shrock, R.E.; Thornton, R.K. (Argonne National Lab., Argonne, IL 60439). pp 581-589 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

A new generation of proton decay experiments is needed to investigate decay modes to which those detectors now in operation or under construction will be relatively insensitive. The experimental limits on the decay rates into various modes should be pushed to levels where neutrino backgrounds dominate. The lifetime where neutrino background becomes important depends strongly on decay mode, but is in the range of 10/sup 30/ to 10/sup 33/ years. Currently available technology is adequate for this task, so this next generation should be started as soon as funds are available. Of course, if proton decay is actually observed in the near future, there will be even stronger motivation to search for it in all possible modes with the new generation of experiments. Proton decay experiments will also be quite sensitive to other very interesting physical phenomena. Even if proton decay does not occur at a detectable rate, the discovery of n n bar or neutrino oscillations, magnetic monopoles, or some totally unexpected phenomenon could justify a large investment in the next generation of experiments.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 39911, 39912, 39925, 39930, 39972, 39973, 39978, 39991, 39996, 39997, 40134

39935 (BONN-HE—86-36) Recent progress with QCD sum rules. Reinders, L.J. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Dec 1986. 27p. NTIS, PC E07; Available from NTIS as TIB/B87-06416.

The spectroscopy of ordinary (anti qq or qqq) hadrons being almost entirely covered, quite a number of papers have gone one step further in considering hybrid anti qqG mesons, especially those which can have exotic quantum numbers like J/sup PC/=1/sup -+/, 0/sup --/, or O/sup +-/, i.e., quantum numbers that cannot be reached by ordinary anti qq combinations. Their experimental discovery would be direct evidence for the presence of gluonic degrees of freedom in the spectrum which would constitute an important new test of QCD and prove that the simple quark model classification scheme has only limited validity. I discuss these calculations in Sec. 3. There appears a growing number of applications of QCD sum rules beyond spectroscopy, in particular calculations of strong interaction contributions to weak interaction phenomena. I discuss the calculation of the K/sup 0/anti K/sup 0/ mixing parameter B of which at present three independent calculations exist (Sec. 4) and the extensive work of Blok and Shifman on nonleptonic decays of charmed mesons (Sec. 5). Sec. 6 is devoted to the decay J/phi->eta/sub c/γ, of which recently new experimental data have been published confirming the older value which is a factor 2-3 smaller than all theoretical predictions. It has been suggested that this discrepancy points to a serious gap in our understanding of the lowest states of charmonium. In addition to the topics mentioned above there have been numerous applications of QCD sum rules to problems in spectroscopy. Two of these are of special interest, since they contain new elements. The first, discussed in Sec. 7, is the work, initiated by Chernyak and Zhitnitskii, of calculating wave functions of hadrons from certain two-point functions. These wave functions are of interest by themselves, but can, in particular, be used for calculating form factors. Secondly, in Sec. (Abstract Truncated)

39936 (DESY—86-015) Can the CERN p anti p collider limit gaugino masses. Baer, H.; Tata, X.; Hagiwara, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Jan 1986. 17p. (ANL-HEP-PR—86-07; OITS—318). NTIS, PC E07; Available from NTIS as TIB/B87-06443.

We show that the hadronic decays of the wino (W) and zino (Z) produced via each of the processes, W -> Wγ, W -> WZ and Z/sup 0/ -> WW lead to a substantial monojet and dijet + p/sub T/ rate at the CERN collider. If the latter two decays are kinematically allowed, one should expect a comparable number of spectacular dilepton and trilepton events with little hadronic activity. In addition, there would also be jet + lepton + p/sub T/ signals. Absence of such signals could lead to the most stringent direct experimental limits on W and Z masses currently possible.

39937 (DESY—86-016) Weak gauge coupling expansion in the lattice-regularized standard SU(2) Higgs model. Montvay, I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1986. 10p. NTIS, PC E07; Available from NTIS as TIB/B87-06442.

The weak gauge coupling expansion is derived in the lattice-regularized SU(2) Higgs model with scalar doublet field at an arbitrary point of the parameter space boundary with vanishing gauge coupling. Consequences of the triviality of the phi/sup 4/ component on gauge invariant Green's functions are formulated.

39938 (INIS-mf—10911, pp 92) **Kaon contribution to the nucleon structure function.** Signal, A.I. (Adelaide Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39939 (INIS-mf—10911, pp 38) **Parity violation from SUSY vertex corrections in deep inelastic scattering.** Hollenberg, L.; McKellar, B.H.J. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39940 (INS-J—170, pp 109-116) **Massless particle and symmetry breaking. Is the meson a Nambu-Goldstone boson.** Aoki, S. (Tokyo Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

We discuss the relation between the existence of the massless particle and the symmetry breaking on a lattice and show that the π meson is the massless particle associated with the parity violation.

39941 (INS-J—170, pp 46-53) **Higgs as (pseudo-) Nambu-Goldstone particles.** Inoue, K.; Takano, H.; Kakuto, A. (Kyushu Univ., Fukuoka, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

Higgs scalars may be (pseudo-) Nambu-Goldstone particles related to a spontaneous breakdown of a global symmetry which contains grand unified gauge group as a subgroup. This hypothesis gives severe constraint on possible form of Higgs mass terms in a framework of supersymmetric grand unified theories coupled to N = 1 supergravity. Remarkably, their tree level mass terms, both supersymmetric and soft-breaking, are definitely given by gravitino mass m_{3}2/ and do not depend on a detailed structure of a superpotential of GUT sector. These mass terms are best desirable for the relatively light top quark(m/sub t/ < approx 50 GeV) suggested at CERN to be active in the radiative SU(2) X U(1) breaking scenario.

39942 (INS-J—170, pp 128-136) Soliton-type solutions with topological indices of SU(2) nonlinear sigma model. Otsuki, S. (Kyushu Univ., Fukuoka, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

Four soliton-type solutions of the SU(2) nonliner sigma model, two of which have the baryon number and the other two do the Hopf index, are systematically examined. One of the two baryonic solutions is the well known Skyrmion.

39943 (INS-J—170, pp 15-18) **Substructures of quarks and leptons and origins of internal quantum numbers.** Akama, K. (Saitama Medical School, Moroyama, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

A motivation of the subquark models is to seek for the origin of the internal quantum numbers of the quarks and leptons in their substructures. There, it is implicitly assumed that the particles with common internal quantum numbers are originated from the common substructures which exhibit the quantum number, which is called single origin hypothesis of the internal quantum number. It is satisfied by the quantum numbers whose origins were already disclosed. The authors seek for composite models where the internal quantum numbers of quarks and leptons, i.e., the color, weak isospin, electric charge and the generation quantum number are all single-originated. To realize the requirement, the fundamental charge k is introduced besides w, h, c and c/sub 0/, taking them mutually dependent. The electric charges of the w, h, c and c/sub 0/ are given as: $Q(w_1) = y + 1/2$, $Q(w_2) = y - 1/2$, $Q(h) = x$, $Q(c) = 1/6$-x-y and Q(c/sub 0/) = -1/2/sub +-x+-y/, where x and y are arbitrary constants. Since Q's are multiples of the fundamental charge, their ratios should be simple integers. Thus, models for each charge assignment can be constructed, as far as the quantum numbers are concerned. In order for these models really to be models, the dynamics should be specified which explains those peculiar selection rules, though no answer to this problem is available at present. If it exists, it should be a saturative and non-confining short-distance force. Subcolor may not be a good candidate. (Nogami, K.).

39944 (INS-J—170, pp 1-14) **Four-fold way.** Terazawa, H. (Tokyo Univ., Tanashi, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

The four-fold way is proposed in a minimal composite model of quarks and leptons. Various new pictures and consequences are presented and discussed. They include 1) generation, 2) quark-lepton mass spectrum, 3) quark mixing, 4) supersymmetry, 5) effective gauge theory.

39945 (INS-J—170, pp 19-27) **Vertical, horizontal and techni-preon model with anomaly-matching.** Koide, Y. (Shizuoka Women's Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

From a composite model which satisfies the 't Hooft's anomaly matching conditions, quarks and leptons f/sub L/ = (5-bar + 10, 3)/sub L/ of SU(5)/sub GUT/ X SU(3)/sub family/ are derived.

39946 (INS-J—170, pp 39-45) **Vacuum energies of string compactified on torus.** Sakai, N.; Senda, I. Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

The heterotic string theory obtains its gauge symmetry by the compactification of the 16-transverse dimensions on torus. It is also suggested that any kind of superstring can be obtained from bosonic tring by the compactification of 16-traverse dimensions on the torus that has periodic boundary condition of E_8 X E_8 lattice. In Kaluza-Klein theories, metrics of the back ground manifolds are usually treated as dynamical variables. Then the shape of the lattice on which extra dimensions of string compactify should be treated as dynamical variables. The true vacuum state in quantum field theory is given by the configuration with the lowest vacuum energies. Here, computation is made for the one-loop vacuum energy of string compactified on various tori. First, a study is conducted on compactiofication on one-dimensional torus, showing that the affine lie algebra for SU(2) X SU(2) is realized as the absolute minimum of the vacuum energy. Compactification of r dimensions is then investigated. An equation is presented for mode expansion of string variables in the compactified directions. There are two possible slutions to the physical condition, i.e., for 1st and 2nd class of compactification. In 2nd class the modular invariance was shown previously. In 1st class, it can be shown numerically that the point where [SU(2) X SU(2)]/sup r/ gauge symmetry appears is the local maximum of the vacuum energy, and the vacuum energy diverges proportional to the volume of the compactified space. A detailed study is also made for the r = 2 case. (Nogami, K.).

39947 (INS-J—170, pp 145-156) **Calculation of the commutator anomaly.** Kobayashi, M.; Sugamoto, A.; Seo, K. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

It is well-known that, for the non-Abelian gauge theory coupled to the chiral fermions, which is described by a Lagrangian, the anomaly of the non-Abelian current is given by the descent form of the Chern-Simon five form; D*J/sup a/ = $(-1/24\pi^2)$tr[d(AdA + $1/2A^3$)], where A = Aμdx/sup μ/ = -it/sup a/Aμ/sup a/dx/sup μ/. Recently, Faddeev argued that, for such an anomalous system, the gauge symmetry would be represented in a generalized sense of projective representation; $V(g_1)V(g_2)PSI(A) = \exp[i\alpha_2(g_1, g_2; A)]$ X V(g/sub $1/g_2$)PSI(A), where PSI(A) is the wave functional and the phase factor α_2 depends on both the group elements and the gauge field configuration A. Here, it is convenient to consider the infinitesimal version of the above argument. The generator of infinitesimal gauge transformation in the temporal gauge A/sub 0/ = 0 is given by G/sup a/(x) = δ/sup i/E/sub i//sup a/ + gf/sup abc/A/sup ib/E/sub i//sup c/ - gPSI-barγ/sup 0/t/sup a/PSI, and the infinitesimal form of the previous product rule can be written as the equal time commutation relation; [G/sup a/(x), G/sup b/(y)] = if/sup abc/G/sup c/(x)δ^3(x-y) + /sup ab/(x,y,A), where is related to α_2. In this equation, the first term is what is expected as the normal commutation relation of the generator, while the second term is an anomaly, which is designated here as the commutator anomaly. Then the present study concentrates on operations to determine the anomaly term. (Nogami, A.).

39948 (JINR-E—2-86-437) **1/N/sub c/ expansion, quark model and hadron collisions at high energies.** Nyiri, J.; Anisovich, V.V.; Nikonov, V.A.; Kobrinskij, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702533.

Soft hadron collision processes at high energies are considered, supposing the short-rangeness of gluon interactions and that the rules of 1/N/sub c/ expansion are fulfilled. It is shown, that these considerations lead to the scheme of the additive quark model with some relatively large additional effects of colour screening. This colour screening is responsible for the unnatural breaking of the Levin-Frankfurt condition and also for the effective increase of cross sections for hadron-nucleus interactions if quark bags in nuclei exist. The formation mechanism of fragmentational particles is considered in multiple hadron production processes. 43 references, 8 figures.

39949 (SLAC-PUB—4270) $Z^0 \rightarrow N_4$ anti nu → monojet. Sun, Hong Rhie. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 7p. (CONF-870278—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010545.

From 4. family of quarks and leptons international symposium; Santa Monica, CA, USA (26 Feb 1987).

We discuss flavor-changing Z decays involving a heavy fourth generation neutrino with mass bigger than M/sub Z//2.

39950 Modular invariance of the thermo-partition function and global phase structure of the heterotic string. O'Brien, K.H.; Tan, C. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Physical Review [Section] D: Particles and Fields;* **36**: No. 4, 1184-1192(15 Aug 1987).

The global phase structure for heterotic string theory is studied. Three different types of representations for thermo-partition functions are provided. We show how modular invariance arises and analyze finite-temperature divergences. A three-phase structure, involving a new nonperturbative high-temperature phase, for the heterotic string is found. The transition into this new phase takes place at $\beta = \pi/\beta$/sub h/T, where β/sub h/ is the conventional "Hagedorn temperature" for the heterotic string.

39951 Necessity of three or more generations for calculable Dirac neutrino masses in E_6 superstring models. Ma, E. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Physical Review Letters;* **59**: No. 5, 607-607(3 Aug 1987).

A Comment on the Letter by G. C. Branco and C. Q. Geng, Phys. Rev. lett. 58, 969 (1987).

39952 Charged particle multiplicity distributions in e/sup +/e/sup -/ annihilation at 29 GeV: A comparison with hadronic data. Derrick, M.; Gan, K.K.; Kooijman, P.; Loos, J.S.; Musgrave, B.; Price, L.E.; Repond, J.; Sugano, K.; Valdata-Nappi, M.; Blockus, D. (Argonne National Lab., USA). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **35**: No. 3, 323-328(Jul 1987). Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125.

The charged particle multiplicity distributions for two-jet events in e/sup +/e/sup -/ annihilation at 29 GeV have been measured using the High Resolution Spectrometer at PEP. A Poisson distribution describes the data for both the complete event and for the single jets. In addition, no correlation is observed between the multiplicities in the two jets of an event. For fixed values of the prong number of the complete event, the multiplicity sharing between the two jets is in good agreement with a binomial distribution. The rapidity gap distribution is exponential with a slope equal to the mean rapidity density. These observations, which are consistent with a picture of independent emission of single particles, are contrasted to the results from soft hadronic collisions and conclusions are drawn about the nature of clusters.

39953 CP violation and rare decays in a discrete symmetry model. Deshpande, N.G. (Institute of Theoretical Science, Univ. of Oregon, Eugene, OR 97403). pp 197-203 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Predictions for CP violations and rare processes are presented in a model based on discrete group S/sub 4/. Earlier predictions regarding Kobayashi-Maskawa angles and top quark mass are briefly summarized.

39954 Some effects of CP violation in SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models. Herczeg, P. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 288-306 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

The author discusses two subjects in the phenomenology of general SU(2)/sub L/ x SU(2)/sub R/ x U(1) models: the effect of W/sub L/-W/sub R/ mixing on the CP-violating parameters ϵ', and the effect of CP violation in W/sub L/-W/sub R/ mixing and in the quark sector on some CP-conserving observables in muon decay, beta decay, and neutrinoless double beta decay.

39955 Neutrino oscillations, and the Wolfenstein-Kobayashi-Maskawa matrix. Rosen, S.P. (T-Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 193-196 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Parameters for neutrino oscillations are derived in a model of fermion masses which leads to the Wolfenstein form of the Kobayashi-Maskawa matrix. Oscillations between ν/sub μ/ and ν/sub e/ are the dominant mode, and the mixing angle is predicted to yield sin/sup 2/2θ (ν/sub μ/$\rightleftharpoons\nu$/sub e/) — . 0.2. Mass values are extracted from recent experiments.

39956 Beyond the standard model. Kane, G.L.; Perl, M.L. (Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109). pp 18-49 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The Standard Model may be correct and it may be fundamental, but it is incomplete. It does what it is meant to do, and it does not address many questions at all. It does not consider or explain the possible (grand) unification of quarks and leptons, and of the various forces in nature; why the Standard Model works i.e. why 3 colors, explicit parity violation, etc.; the origin of mass, and the need for scalar bosons; and the origin of flavors, and how many flavors. It is these topics which all of the approaches to Beyond the Standard Model attempt to resolve. In a sense, the main question is how to find experimental clues to these problems. Although the Standard Model is not yet fully established [at a minimum it is necessary to find Z^0, W/sup +-/, find or understand a Higgs boson, measure radiative corrections, and test QCD scaling violations and multijet behavior], our working hypothesis is that the Standard Model can be used to study how to go Beyond the Standard Model. In particular, any hypothetical new particle which carries electric charge will couple to a photon and can be produced in e/sup +/e/sup -/ collisions, any particle which carries weak isospin couples to the Z^0 and will appear in Z^0 decay if energetically allowed, and any particle which carries color will couple to gluons and can be produced in hadron collisions. All of these production rates are calculable (with appropriate uncertainties). Similarly, many decay signatures can be discussed in terms of Standard Model properties.

39957 Predicted properties of the W/sup +-/ and Z/sup 0/. Marciano, W.J.; Parsa, Z. (Brookhaven National Lab., Upton, NY 11973). pp 155-158 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Predicted properties of the W/sup +-/ and Z/sup 0/ bosons in the standard SU(2) x U(1) model are presented. For the current value of the weak mixing angle, sin/sup 2/θ/sub W/(m/sub W/) = 0.215 +- 0.014, one finds m/sub W/ = 83.0/sub - 2.8//sup + 3.0/ GeV and m/sub Z/ = 93.8 /sub - 2.4//sup 2.5/ GeV. Implications of deviations from these predictions are discussed. Decay rates and branching ratios for the W/sup +-/ and Z/sup 0/ are given. Radiative corrections, higher order rare decays and exotic possibilities are described.

39958 Vector meson backgrounds at high energy ee-bar machines. Hinchliffe, I. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 438-440 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

This paper presents cross sections for ee-bar $\rightarrow$ W/sup -/W/sup +/, ZZ, Zγ at high energies. The first of these is available in the LEP reports but the remaining two seem to be unavailable. These cross-sections represent a background to potentially interesting physics on mass scales of order 1 TeV. They are large due to t channel lepton exchange diagrams. Higgs diagrams are neglected; they are zero if the electron mass is set to zero.

39959 **W,Z^0 production at a PP collider.** Bunce, G.; Gordon, H.A.; Killian, T.J.; Murtagh, M.J.; Paige, F.E.; Tannenbaum, M.J.; Trueman, T.L.; Branson, J.; Eisler, F.; Grannis, P. (Brookhaven National Lab., Upton, NY 11973). pp 489-499 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Since the authors wish to focus on rates and on the effectiveness of topological cuts they have to consider a schematic detector. The detector is assumed to cover $\Delta y = +-2$ (i.e. a 15^0 beam cone is excluded) andΔphi $= 2\pi$. It has electromagnetic and hadronic calorimeters. They are segmented in towers pointing to the interaction diamond. Each tower covers 5^0 in Θ and 9^0 in phi. The authors have assumed an electron identification system (e.g. transition radiation detector) which give $\pi/e \approx 1/1000$ in a test beam or $\approx 1/100\ \pi$ rejection in the experience discussed here. The detector is assumed to have a magnetic field so that at least the signs of the leptons can be determined. However, at present, the particles are not tracked in the field but are projected directly from the interaction point to the detector. Where detailed studies of the rates and backgrounds were made they used appropriate event sets generated by the ISAJET Monte Carlo program. In general it is easy to generate adequate signal events. However for integrated luminosity $\approx$ 10/sup 40/cm/sup -2/ the generation of adequate background events is not trivial as one is usually dealing with the tails of distributions. Specific topics considered are: W/sup +-/ production: pp $\rightarrow$ W/sup +-/ + X, W/sup +-/ $\rightarrow$ e/sup +-/ + ν; pp $\rightarrow$ W/sup +-/ + γ + X; polarization effects in W/sup +-/ production; and very high luminosity experiments.

39960 **Mass limits for the muon neutrino.** Hoffman, C.M.; Sandberg, V.D. (Los Alamos National Lab., Los Alamos, NM 87545). pp 552-555 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The possibility of improving the present limit on the mass of the muon neutrino is discussed. It is found that decays of muons and pions are not useful means to significantly improve this limit. On the other hand, the decays K/sub L//sup 0/ $\rightarrow$ π/sup +-/μ/sup -+/ν/sub μ/ and K/sup +/ $\rightarrow$ π/sup 0/μ/sup +/ν/sub μ/ appear to be quite promising. Possible experiments are discussed.

39961 **Properties of toponium.** Jackson, J.D.; Olsen, S.; Tye, S.H.H. (Dept. of Physics and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 175-180 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

In this report, the authors examine the properties of the bound states Θ (tt-bar) of t and t-bar quarks and the possibilities of studying these bound states at different machines. Consistency of the standard electroweak model requires the presence of a top quark t. The standard model also allows (but does not require) the existence of a fourth family of quarks and leptons. Therefore, the discussion with appropriate modifications, can easily be applied to any heavy quark.

39962 **Future requirements for glueball/meson spectroscopy.** Chanowitz, M.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 194-196 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC03-76SF00098.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

To discover and identify the glueball spectrum expected in Q.C.D. it is essential to understand in detail the very complicated spectrum of mesons between 1 and 2 1/2 GeV. To this end existing programs with fixed targets must be extended to even higher levels of statistics. Depending on the particular process, this may require more intense beams, faster detectors, on-line event selection, and more rapid data analysis. Radiative J/psi decay plays a special role in the search because glueballs should appear there with enhanced rates and signal-to-noise ratios. Although we were lucky in the case of the glueball candidates i and θ, it is likely that most of the new states will not be visible in mass histograms unaided by partial wave analysis. Progress requires increasing the statistical level in J/psi decays by one or more orders of magnitude so that the methods of partial wave analysis can be applied. To achieve this a J/psi factory is needed, which could be a new facility or an upgrade of an existing facility.

39963 **Detecting supersymmetric hadrons.** Aronson, S.H.; Littenberg, L.S.; Paige, F.E.; Stumer, I.; Weygand, D.P. (Brookhaven National Lab., Upton, NY 11973). pp 505-509 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Supersymmetric grand unified models are of interest because they offer a possible explanation of the great disparity between the W mass and the grand unified scale (about 10/sup 15/ GeV). In such models each of the familiar particles (gluons, quarks, etc.) has a partner differing by 1/2 unit of spin, presumably with a mass of order the W mass or less. Supersymmetry ensures that the couplings of the partners of the gluons and quarks to normal hadronic constituents are of about the usual QCD strength. Thus production cross-sections for these states need not be particularly small. In the present paper the authors investigate the possibility of detecting the supersymmetric partners of gluons and quarks at a 400 x 400 GeV/c proton-proton collider. The prospects for detecting the supersymmetric partners of gluons and quarks at a high luminosity 400 x 400 GeV/c pp collider are quite good, if these particles lay in the theoretically interesting mass range — M/sub W/.

39964 **ISAJET: A Monte Carlo event generator for pp and p-barp interactions. Version 3.** Paige, F.E.; Protopopescu, S.D. (Brookhaven National Lab., Upton, NY 11973). pp 471-477 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

ISAJET is a Monte Carlo computer program which simulates pp and p-bar p reactions at high energy. It can generate minimum bias events representative of the total inelastic cross section, high P/sub T/ hadronic events, and Drell-Yan events with a virtual γ, W/sup +-/, or Z/sup 0/. It is based on perturbative QCD and phenomenological models for jet fragmentation.

39965 **Cross sections at hadron colliders.** Paige, F.E. (Brookhaven National Lab., Upton, NY 11972). pp 484-488 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC02-76CH00016.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The hadron-hadron collider group has considered pp and p-bar p colliders at energies $\sqrt{s} = .8, 2, 10$, and 40 TeV and at luminosities up to 10/sup 34/cm/sup -2/ sec/sup -1/. In this paper the predicted cross sections are given for new Z'/sup 0/ bosons, for the Drell-Yan continuum of μ/sup +/μ/sup -/ pairs, for high P/sub T/ hadron jets, for high P/sub T/ single photons, and for the associated production of heavy quarks. These processes have been selected not to cover the most interesting physics, but to provide a

representative selection of cross sections for which to compare various energies and luminosities.

39966 **Search for new heavy techniparticles.** Baltay, C.; Gordon, H. (Columbia Univ., New York, NY 10027). pp 500-504 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

In this article, the authors consider in some detail an experiment to search for the Technieta (/sub eta T/), which is expected to be in the 100 to 300 GeV mass range. For the sake of concreteness they use the predictions of the technicolor models; however, it might be better to think of these considerations as an example of the kind of searches that should be carried out with the next generation of hadron-hadron colliders, without putting too much importance on the details of the theoretical models that happen to be in fashion at this time. The general notion of a — TeV mass scale and the rough value of the coupling strengths of the new mass scale to the present quarks, leptons and gluons seem more reliable than details of the particular models.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 39939, 39951, 39953

39967 **(DOE/ER/40048—23-N7) Introduction to time reversal theory.** Henley, E.M. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 12p. (CONF-8704152—1). NTIS, PC A02. File Number DE87011080.

From Workshop on tests of time reversal invariance in neutron physics; Chapel Hill, NC, USA (17 Apr 1987).

Theory and reaction mechanisms relevant to time reversal invariance are reviewed. Consequences of time reversal invariance are presented under the headings of CP tests, electromagnetic moments, weak emissions or absorptions, and scattering reactions. 8 refs., 4 figs.

39968 (INIS-mf—10911, pp 33) **Aharnov-Bohm effects for non-albelian gauge fields.** Tassie, L.J.; Sundrum, R. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39969 (INIS-mf—10911, pp 53) **Supersymmetric nonlinear σ-models of composite quarks and leptons.** Volkas, R.R. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39970 **Cohomology and heterotic world-sheet anomalies.** Louis, J.; Ovrut, B.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396). *Physical Review [Section] D: Particles and Fields;* **36**: No. 4, 1119-1126(15 Aug 1987).

Topological methods are applied to calculating world-sheet anomalies in (p,q) supersymmetry. Specifically, we construct the (1,0) gauge anomaly using cohomology and the descent equations in (1,0) superspace. The coefficient of the anomaly is calculated with supergraph techniques.

39971 **Simple discrete symmetries in phenomenologically viable E_6 superstring models.** Drees, M.; Tata, X. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **59**: No. 5, 528-531(3 Aug 1987).

We analyze the simplest discrete symmetries of the superpotential of superstring-inspired E_6 models necessary to simultaneously suppress (i) proton decay, (ii) neutrino masses, and (iii) tree-level flavor-changing neutral currents in E_6 superstring models without any intermediate scale. We show that there are two and only two different Z_2 symmetries that incorporate (i)—(iii). These symmetries put restrictions on the decays of exotic particles; in particular, the exotic quarks always decay semileptonically. A Z_3-symmetric model satisfying (i)—(iii) and with $\mu \rightarrow e\gamma$ forbidden is also constructed.

39972 **Is CP violation maximal.** Gronau, M. (Dept. of Physics, Technion-Israel Institute of Technology, Haifa). pp 266-275 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Two ambiguities are noted in the definition of the concept of maximal CP violation. The phase convention ambiguity is overcome by introducing a CP violating phase in the quark mixing matrix U which is invariant under rephasing transformations. The second ambiguity, related to the parametrization of U, is resolved by finding a single empirically viable definition of maximal CP violation when assuming that U does not single out one generation. Considerable improvement in the calculation of nonleptonic weak amplitudes is required to test the conjecture of maximal CP violation.

39973 **Phenomenological consequences of supersymmetry.** Hinchliffe, I.; Littenberg, L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 242-258 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

This paper deals with the phenomenological consequences of supersymmetric theories, and with the implications of such theories for future high energy machines. The paper represents the work of a subgroup at the meeting. The authors are concerned only with high energy predictions of supersymmetry; low energy consequences (for example in the K/sub o/K-bar/sub o/ system) are discussed in the context of future experiments by another group, and will be mentioned briefly only in the context of constraining existing models. However a brief section is included on the implication for proton decay, although detailed experimental questions are not discussed.

6454 Field Theory

REFER ALSO TO CITATION(S) 39921, 39950, 39956, 39961, 39962, 39965, 39968, 39970, 40094, 40136, 40309

39974 **(DESY—86-034) Volume dependence of the energy spectrum in massive quantum field theories. Pt. 2. Scattering states.** Luescher, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1986. 81p. NTIS, PC E09; Available from NTIS as TIB/B87-06379.

The low-lying energy values associated to energy eigenstates describing two stable particles enclosed in a (space-like) box of size L are shown to be expandable in an asymptotic power series of 1/L. The coefficients in these expansions are related to the appropriate elastic scattering amplitude in a simple and apparently universal manner. At low energies, the scattering amplitude can thus be determined, if an accurate calculation of two-particle energy values is possible (by numerical simulation, for example).

39975 (INIS-mf—10911, pp 37) **Dynamically selected vacuum field configuration in massless QED.** Roberts, C.D.; Cahill, R.T. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39976 (INIS-mf—10911, pp 39) **Measurement of the chiral condensate in lattice QCD.** Burden, C.J.; Barbour, I.M. (Australian National Univ., Canberra; Glasgow Univ., England). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39977 (INIS-mf—10911, pp 49) **Supersymmetry - in nuclear and particle physics.** Jarvis, P.D. (Tasmania Univ., Sandy Bay, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39978 (INIS-mf—10911, pp 59) **Covariant calculation of rho -> π π decay in QCD using a 1/N/sub c/ colour expansion.** Praschifka, J.; Roberts, C.D.; Cahill, R.T. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39979 (INIS-mf—10911, pp 80) **Unexpected restrictions of a quaternionic quantum field.** Nash, C.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39980 (INIS-mf—10911, pp 83) **Analytic calculation of Feynman integrals in axial gauge using recursion relations.** Slim, H.A. (Murdoch Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39981 (INIS-mf—10911, pp 52) **Relativistic fermions in periodic structures.** McKellar, B.H.J. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39982 (INIS-mf—10911, pp 28) **Linked cluster expansions for SU(3) Yang-Mills theory.** Hamer, C.J.; Irving, A.C.; Preece, T.E. (Australian National Univ., Canberra; Liverpool Univ., England). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

39983 (INS-J—170, pp 89-108) **Yet another Monte Carlo study of the Schwinger model.** Sogo, K.; Kimura, N. (Tokyo Univ., Tanashi, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

Some methodological improvements are introduced in the quantum Monte Carlo simulation of the 1 + 1 dimensional quantum electrodynamics (the Schwinger model). Properties at finite temperatures are investigated, concentrating on the existence of the chirality transition and of the deconfinement transition.

39984 (INS-J—170, pp 117-127) **Quantum Hall effect.** Ishikawa, K. (Hokkaido Univ., Sapporo, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

A proof of the quantization of the antisymmeric part of the conductivity tensor in general 2 + 1 dimensional fermion theory based on Ward-Takahashi identity and an equivalence of a system of planar electrons under strong magnetic field with a multi-component fermion theory are given. Combining two relations mentioned above, we have a general proof of the (integer) quantization of the Hall conductivity.

39985 (INS-J—170, pp 159-176) **Non-perturbative effects of background fields.** Hosoda, M.; Yamakoshi, H.; Shimizu, T. (Tokyo Metropolitan Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

APS-index of the Abelian Higgs model is at first obtained in a bounded domain of a disk with radius R. It is shown that the APS-index depends strongly on the behavior of the background fields and becomes integer when boundary effects are taken into account. Next, the electric charge of the vacuum is reconsidered in the momopole field coupled to a massive Dirac particle. It is reconfirmed that the monopole ground state has an electric charge θ/π which changes discontinuously to zero when the fermion mass is zero.

39986 (INS-J—170, pp 28-38) **Covariant formulation of interacting string field theory.** Itoh, K. (Kyoto Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

A covariant field theory of interacting bosonic (open) string is constructed based on the BRS formalism. It exactly reproduces on-shell physical tree amplitudes of the light-cone field theory.

39987 (INS-J—170, pp 137-144) **Z_3 - invariant effective theory of deconfining phase transition. Effective theory of QCD phase transitions.** So, H. (Tokyo Univ., Tanashi, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

A Z_3-invariant scalar model is proposed as an effective theory of deconfining phase transition of QCD. Coupling constants in the potential are determined by Monte Carlo methods. The structure of renormalization trajectories for coupling constants is investigated.

39988 (INS-J—170, pp 74-82) **Cosmic ray test for supersymmetry.** Midorikawa, S.; Yoshimoto, S. (Tokyo Univ., Tanashi, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

The photino can be the lightest supersymmetric particle and may be produced copiously in the stellar objects. We investigate the interactions of a light-photino with the matter and find that the production cross sections in resonance regions are the largest and that the production of fermions with their superpartners is important at higher energies. However the photino flux in cosmic ray is too small to be detected.

39989 (INS-J—170, pp 83-88) **Hadron spectrum in quenched QCD.** Iwasaki, Y. (Tsukuba Univ., Sakura, Ibaraki, Japan). Mar 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780129. (CONF-8512123—).

From 6. INS winter seminar on structure and forces in elementary particle physics; Tokyo, Japan (16 Dec 1985).

I report results of the calculations of the hadron spectrum with a renormalization group improved lattice gauge action on a $16^3 \times 32$ lattice as well as on a $12^3 \times 24$ lattice in the quenched (valence) approximation which neglects dynamical quark loops.

39990 **Instability of the translationally invariant vacuum of a system of fermions coupled to a chiral field.** Ripka, G.; Kahana, S. (Service de Physique Theorique, Centre d'Etudes Nucleaires de Saclay, F-91191 Gif-sur-Yvette Cedex, France). *Physical Review [Section] D: Particles and Fields;* **36**: No. 4, 1233-1239(15 Aug 1987).

It is shown, in the case of fermions coupled to a chiral field, that for every value of the coupling constant the energy of the B = 0 sector is lower for a localized chiral field than for a translationally invariant (uniform) field. An expansion is given which converges for fields localized in a region of space smaller than the inverse mass of the fermions and which in lowest order explains the vacuum deformation. Exact energies are calculated for a hedgehog field. The instability of the uniform vacuum is found to increase with the winding number of the chiral field.

39991 **Dirac neutrinos in guts.** Sarkar, U. (Center for Particle Theory, Univ. of Texas, Austin, TX 78712). pp 405-414 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

Some of the recent experimental results can be explained by considering the electron neutrino to be a Dirac particle. In the present article, the possible grand unified theories of generating such ultralight Dirac neutrinos in a natural way are reviewed.

39992 **A better lattice gauge theory.** Cahill, K.; Reeder, R. (Dept. of Physics and Astronomy, Univ. of New Mexico, Albuquerque, NM 87131). pp 67-72 of Coherence, cooperation and fluctuations. Haake, F.; Narducci, L.M.; Walls, D.F. New York, NY; Cambridge University Press (1985). (CONF-8510395—).

From Symposium in honor of Roy J. Glauber, Harvard University: coherence, cooperation and fluctuations; Cambridge, MA, USA (19 Oct 1985).

The authors show that for U(1)/sub 3/ the simplicial version of lattice gauge theory provides a more accurate way of computing Creutz ratios of Wilson loopos than does Wilson's version. The higher accuracy of the simplicial method is due to its use of the action and domain of integration of the exact theory, unaltered apart from the granularity of the simplicial lattice.

39993 **A general analysis of the chiral phase transition.** Pisarski, R.D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 177-198 of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

The universality classes applicable to the chiral phase transition are studied. The ϵ-expansion predicts that the chiral transition should always be of first order for three or more flavors. If fluctuations with topological charge evaporate at temperatures well below the chiral transition point, a new phase of hadronic matter could occur, one in which there would be massive violations of isospin.

39994 **Computations of finite temperature QCD with the pseudofermion method.** Fucito, F.; Solomon, S. (Universita di Roma II, Tor Vergata, Via. O. Raimondo, 00173 Roma). pp 213-224 of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

The authors discuss the phase diagram of finite temperature QCD as it is obtained including the effects of dynamical quarks by the pseudofermion method. They compare their results with the results obtained by other groups and comment on the actual state of the art for these kind of computations.

39995 **Cygnum X-3, ultra-relativistic nuclear collisions, high density matter, and other stuff which we don't know too much about.** Mclerran, L. (Theory Dept., Fermilab P.O. Box 500, Batavia, IL 60510). pp 225-246 of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

The author discusses striking features of QCD which have not yet either been fully experimentally verified, or in his opinion, satisfactorily computed in lattice gauge theory. He summarizes present qualitative and semi-quantitative insight into these features of QCD, and how these features might appear either naturally, or in controlled accelerator experiments.

39996 **Standard model group, QCD subgroup - dynamics isolating and testing the elementary QCD subprocess.** Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY 11973). pp 184-193 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

QCD to an experimentalist is the theory of interactions of quarks and gluons. Experimentalists like QCD because QCD is analogous to QED. From a previous study on the validity of QED, one has a ready-made menu for tests of QCD. There are the static and long distance tests such as: the value of the coupling constant α/sub s/; the shape of the QCD potential and "onia" spectroscopy in analogy to atomic spectroscopy and tests of Coulomb's law at large distances. (One might try to imagine the QCD analogue of g-2 and the Lamb shift.); and tests of confinement: i.e., can you break up a proton into 3 quarks? These topics are covered in the static properties group. In this report, dynamic and short distance tests of QCD are discussed, primarily via reactions with large transverse momenta. This report is an introduction and overview of the subject, to serve as a framework for other reports from the subgroup. In the last two sections, the author has taken the opportunity to discuss his own ideas and opinions.

39997 **"Other" QCD tests.** Bunce, G. (Brookhaven National Lab., Upton, NY 11973). pp 199-201 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

There are two testing grounds for strong-interaction theory (call this QCD) which are not usually included in discussions about either present or future QCD tests: inclusive polarization and exclusive reactions. This paper presents quite an extensive program of exclusive QCD tests which is very different from inclusive experiments at higher energy. To evaluate its relative contribution to understanding strong interactions, the author needs to see whether reliable QCD predictions are developed for exclusives; these predictions are significantly different from, say, statistical models, and the measured reactions in the initial experiments have some interesting behavior - i.e., all the ratios are not 1, or some of the particles have significant polarization.

65 PHYSICS II

39998 **(INIS-mf—10911) 11th AINSE nuclear physics conference, 3rd-5th February 1986, School of Physics - Laby Theatre, University of Melbourne. Conference handbook.** (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1986. 104p. (CONF-860233—Absts.). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489.

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

Abstracts of papers, the conference program and general information is included in the conference handbook.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 39486, 39487, 39500, 40039, 40099, 40240

39999 **(CONF-860741—24) Electromagnetic properties of nuclei at high spins.** Leander, G.A. (Oak Ridge Associated Universities, Inc., TN (USA)). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02. File Number DE87010896.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

A photon emitted by an excited state is likely to carry away, at most, 1 or 2 h-bar of angular momentum. Therefore, a profusion of photons is needed to deexcite the rapidly rotating states of nuclei formed by heavy-ion reactions. The study of electromagnetic properties has become the primary source of information on nuclear structure at high spins and, also, at the warm temperatures present in the initial stage of the electromagnetic cascade process. The purpose of this paper is a review of the E1, M1, and E2 properties of such highly excited states. 42 refs., 5 figs.

40000 **(JAERI-M—86-121) Development of nuclear decay data library JDDL, and nuclear generation and decay calculation code COMRAD.** Naito, Yoshitaka; Ihara, Hitoshi; Katakura, Jun-ichi; Hara, Toshiharu. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 165p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702521.

For safety evaluation of nuclear fuel facilities, a nuclear decay data library named JDDL and a computer code COMRAD have been developed to calculate isotopic composition of each nuclide, radiation source intensity, energy spectrum of γ-ray and neutron, and decay heat of spent fuel. JDDL has been produced mainly from the evaluated nuclear data file ENSDF to use new nuclear data. To supplement the data file for short life nuclides, the JNDC data set was also used which had been evaluated by Japan Nuclear Data Committee. Using these data, calculations became possible from short period to long period after irradiation.

40001 **(RCNP-P—74) Workshop on the next plan for the study of 'physics of fast neutron reactions and measurements'.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Mar 1985. 87p. (In Japanese). (CONF-8412129—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702545.

From Workshop on the next plan for the study of physics of fast neutron reactions and measurements; Ibaraki, Japan (25 Dec 1984).

A work shop titled "Physics of fast neutron reaction and measurements" was held on 25 December 1984, where discussions were made on the new approach and techniques for neutron measurements. The possibilities of experimental tests with AVF cyclotron was also discussed. The followings are the list of papers presented at the work shop (all papers are written in Japanese except for the abstracts). (1) Monoenergetic neutron beam in Tohoku Cyclotron. (2) Spin-dependent response probed in (p,n) and (n,p) reactions. (3) Measurement of D(n,p) 2n reaction and instrumentation for (n,x) reactions in the 40 - 80 MeV region. (4) Two comments related to the neutron reaction. (5) High energy neutron production facilities in the world and a possibility of neutron induced reaction experiments at RCNP. (6) A neutron counter by detection of recoil protons with solid state detectors and development of neutron source by heavy ions. (7) The measurement of neutrons with the recoil detector. (8) Polarization transfer measurements (Py, Dss, Ds/sub 1/, center dot center dot center dot) with fast neutron beams. (9) Neutron elastic scattering. (10) Neutron capture gamma reaction and effective charge. (11) Comparison between neutron and charged particle induced reactions. (12) Study of giant resonances by fast neutrons. (Aoki, K.).

40002 **(RCNP-P—75) Report of the workshop on nuclear polarization phenomena.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1985. 200p. (In Japanese). (CONF-8412130—). NTIS (US Sales Only), PC A09/MF A01. File Number DE87702546.

From Workshop on nuclear polarization phenomena; Ibaraki, Japan (20 Dec 1984).

The third work shop on the study of the nuclear polarization was held in December 1984 at RCNP (Research Center for Nuclear Physics). Osaka University, in advance of the comming international conference. About 80 researchers gathered and discussed both theoretical and experimental aspects of nuclear polarization phenomena. Forty eight papers were presented at the work shop and they are collected in this report. Although almost all of them are written in Japanese, the abstracts are prepared in English. (Aoki, K.).

40003 **(UCRL—52000-87-6) Energy and Technology Review, June 1987.** Lear, R.D.; Crawford, R.B.; de Vore, L.; Hendry, D.P.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012502.

A short review is presented of four current research projects at the Lawrence Livermore National Laboratory. A heavy ion spectroscopy system is described which makes possible more precise and sensitive measurements of the radiation emitted by highly charged ions. This capability is used to study atomic structure. An electron beam ion trap makes it possible to measure ion-electron interaction cross sections for highly charged ions. A new tandem accelerator laboratory is described. Finally, research in isotope ratio mass spectrometry has extended mass spectrometry capabilities for accurately measuring isotope ratios to subnanogram sized samples. 14 refs., 20 figs., 4 tabs. (DWL)

40004 **Recent References: January through April 1987.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973). *Nuclear Data Sheets;* **51**: No. 3, 481(Jul 1987). Contract AC02-76CH00016.

Key number and reaction indexes along with a bibliography are presented for all literature received by the National Nuclear Data Center or assigned key numbers between January and April 1987. (AIP)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

40005 (INIS-mf—10911, pp 48) **$^{12}C(\gamma,n)$ cross section at 65 deg and energies from E_γ = 30 MeV to 100 MeV using tagged photons.** Harty, P.D. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

6513 Nuclear Properties And Reactions, A=6-19, Experimental

40006 **(AD-A—955248/0/XAB) Angular distribution of 12-MeV gamma-rays from proton bombardment of boron 11.** Jenkins, G.L.; Cochran, L.W.; Kern, B.D.; Hahn, T.M. (Kentucky Univ., Lexington (USA). Research Foundation). 1 Jul 1953. 4p. NTIS, PC A02/MF A01.

Pub. in the Physical Review, Vol. 91, No. 4, 915-917(15 Aug 1953).

40007 **(CONF-8706113—3) Close collisions between light nuclei: Orbiting and fusion.** Shapira, D.; Shivakumar, B.; Harmon, B.A.; Ayik, S. (Oak Ridge National Lab., TN (USA); Yale Univ., New Haven, CT (USA). Nuclear Structure Lab.; Virginia Univ., Charlottesville (USA); Tennessee Technological Univ., Cookeville (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011178.

From 6. Adriatic international conference on nuclear physics; Dubrovnik, Yugoslavia (15 Jun 1987).

Our data have demonstrated that in close collisions the two nuclei first form a rotating dinuclear complex (DNC) which can break up into two complex fragments (Orbiting) or evolve into a compound nucleus. The binary fragment yield was found to be significant in contradiction with earlier views which held that whenever nucleus-nucleus capture occurs fusion is a certainty. The time duration of the dinuclear stage and the nature of its evolution into a compound nucleus were studied and a model which describes these processes will be presented. 25 refs., 14 figs.

40008 (INIS-mf—10911, pp 50) **Pick-up reaction $^{13}C(p,d)^{12}C$ induced by 120 MeV polarized protons.** Lewis, P. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40009 (INIS-mf—10911, pp 24) **Anomalous analyzing power for one $^{11}B(d,n)^{12}C$ reaction to the 2^+ state at 4.44 MeV.** Foot, P.B.; Shute, G.G.; Spicer, B.M. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40010 (INIS-mf—10911, pp 56) **Photodisintegration of ^{17}O leading to excited residual states.** O'Reilly, G.V.; Thompson, M.N. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40011 (INIS-mf—10911, pp 72) **Absolute determination of the ^9Be (γ, p) reaction cross section.** McLean, D.J.; Zubanov, D.; Thompson, M.N. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40012 **(KFK—4246) Investigation of the antiprotonic X-ray spectra of the isotopes /sup 6/Li, /sup 7/Li and /sup 40/Ca.** Barth, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Apr 1987. 105p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10184.

With the commissioning of the Low-Energy Antiproton Ring (LEAR) at CERN in Geneva a high intensity, high purity antiproton beam became available, enabling precision measurements of antiprotonic X-ray spectra to be carried out. Besides informations about properties of the elementary particle antiproton itself, as for example its mass and its magnetic moment, such measurements provide informations about the strong-interaction potential between antiproton and nucleus at very low energies, which, in turn, can be derived from the elementary antinucleon-nucleon interaction by using microscopic models. This work investigates the antiprotonic X-ray spectra of the isotopes /sup 6/Li, /sup 7/Li and /sup 40/Ca. The data were taken during the experiment PS176 at LEAR. The strong interaction between antiproton and nucleus leads to an energy shift ϵ and an absorption width Γ of the lower level of the last observable transition and also to intensity reductions, which can be converted to an absorption width for the upper level. For the isotopes /sup 6/Li, /sup 7/Li and /sup 40/Ca the following results were obtained: /sup 6/Li: $\epsilon(2p)=(-215 \pm 25)$ eV, $\Gamma(2p)=(660 \pm 170)$ eV and $\Gamma(3d)=(135 \pm 16)$ meV, /sup 7/Li $\epsilon(2p)=(-265 \pm 20)$ eV, $\Gamma(2p)=(690 \pm 170)$ eV and $\Gamma(3d)=(129 \pm 13)$ meV, /sup 40/Ca: $\epsilon(4f)=(-1060 \pm 130)$ eV, $\Gamma(4f)=(3670 \pm 600)$ eV and $\Gamma(5g)=(34.9 \pm 3.3)$ eV. The results are in fair agreement with theoretical calculations, at the same time showing up the limits of present understanding of antiproton-nucleus interaction. Particularly the spin-orbit part of the strong interaction seems to play a nonnegligible role.

40013 **(UCID—21064) HOTSPUR: Neutron and gamma-ray emission from the transport of 14 MeV neutrons through H_2O.** Goldberg, E.; Hansen, L.F.; Howerton, R.J.; Komoto, T.T.; Pohl, B.A. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 19p. NTIS, PC A2/MF A01; GPO Dep. File Number DE87010549.

A series of measurements were previously performed at LLNL on many materials from Be to U-238 to study the gamma ray leakage spectra resulting form the interactions of 14 MeV neutrons with these materials. Sizable discrepancies were found in these experiments between measured and calculated gamma ray induced recoil electron spectra, while the agreement among the respective measured and calculated neutron spectra was quite good. The present report discusses the same type of measurements and calculations for 0 to 16 and serves to illustrate the above discrepancies. A water filled glass vessel was the target used to study the transport of 14 MeV neutrons through 0 to 16 and the respective emission of secondary neutrons and gamma rays. The design and execution of the experiment and the re-evaluations of the nuclear cross section data base for 0 to 16 in the ENDL library (that resulted in a considerable improvement in the agreement with the measured electron recoil spectra) are presented. 11 refs., 8 figs., 2 tabs.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

40014 **(GSI—87-2) Comparison of the production of neutral pions and high-energetic photons in heavy ion collisions at intermediate incident energies.** Grimm, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Heidelberg Univ. (Germany, F.R.)). Jan 1987. 123p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06415.

In the present thesis the production of neutral pions and high-energetic photons (E/sub γ/ $\geqq$ 50 MeV) in heavy ion collisions at incident energies of 20 and 84 MeV/u was studied. Thereby it was cared much about to detect both samples in the same reactions in order to obtain conclusions on a possible common production mechanism. The spectra of the pions and photons decrease exponentially and are described at fixed projectile energy in all systems studied by the same value for the decreasement parameter. This is compatible with the assumption that their source system consists always of equally much nucleons of the projectile and the target. The maximum possible number of nucleons (in a central collision) is by this determined by the smaller of the contributing nuclei. An experimental hint for this is to be seen in the pion spectra observed under forward (0/sup 0/) and backward (180/sup 0/) angles which show for a source system moving with half of the beam rapidity the same exponential decreasing. Also the angular distribution of the photons under the assumption of the emission from such a system is symmetric relative to the 90/sup 0/ direction. A corresponding representation of the angular distribution of the pions doesn't show this symmetry because it is influenced by the absorption of the pions in the surrounding nuclear matter. From the contribution in the cross section missing at the side of the larger of the two nuclei the strength of the absorption can be determined. It represents a large contribution of the measured yield, for instance in the system /sup 18/O + Ta about 70% of the measured value are lossed by absorption. (orig./HSI).

40015 (INIS-mf—10911, pp 47) **Effects of quadrupole deformation in scattering of 52 MeV vector polarized deuterons from s-d shell nuclei.** Nurzynski, J.; Kihm, T.; Knopfle, K.T.; Mairle, G. (Australian National Univ., Canberra; Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany, F.R.). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40016 (INIS-mf—10911, pp 44) **Elastic and inelastic scattering of ^{16}O by ^{24}Mg at 90 deg C.M. .** Drumm, P.V.; Hebbard, D.F.; Nurzynski, J.; Ophel, T.R.; Robson, B.A.; Smith, R. (Daresbury Lab., England; Australian National Univ., Canberra; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40017 (INIS-mf—10911, pp 20) **How good is the N=20 shell closure when Z<<N?. II. Masses and levels of ^{34}Si and ^{35}P.** Woods, C.L.; Fifield, L.K.; Drumm, P.V.; Bark, R.A. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40018 (INIS-mf—10911, pp 23) **How good is the N=20 shell closure when Z<<N?. I. The mass of ^{33}Al.** Fifield, L.K.; Chapman, R.C.; Durell, J.L.; Mo, J.N.; Smith, R.C.; Woods, P.L.; Cunningham, R.A.; Drumm, P.V.; Fulton, B.R. (Australian National Univ., Canberra; Manchester Univ., England; Daresbury Lab., England). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40019 (INIS-mf—10911, pp 26) **Excitation functions for ^{24}Mg(^{16}O,^{16}O')^{24}Mg* (0- 8.4 MeV) scattering at forward angles.** Nurzynski, J.; Hebbard, D.F.; Ophel, T.R.; Kondo, Y.; Robson, B.A.; Smith, R. (Australian National Univ., Canberra; Central Studies Establishment, Department of Defence, Canberra, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40020 (INIS-mf—10911, pp 68) **Neutron rich nuclei near the N=20 shell closure: studies of ^{31}Al, ^{35}Si, ^{36}P, ^{37}P and ^{39}S.** Catford, W.N.; Drumm, P.V.; Fifield, L.K.; Orr, N.A.; Woods, C.L. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40021 **(INS—588) Photonuclear spallation reactions in Cu.** Shibata, S.; Imamura, M.; Miyachi, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702496.

Formation yields of 24 radioactive nuclides by the interaction of bremsstrahlung in the maximum end-point energies of 100 MeV - 1 GeV with Cu have been measured by direct γ-ray counting of irradiated targets. The yields in the mass range of 42 to 60 except for ^{60}Cu were analysed by non-linear least-squares fit to construct the mass yield and charge dispersion curves in spallation reactions. From the parameter values obtained, the energy dependence of the slope of the mass yield curve and the relationship between target N/Z and the most probable product N/Z were investigated in comparison with the results of proton, α and heavy ion-induced spallations of Cu. The characteristics of photon-induced spallations are discussed.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

40022 (INIS-mf—10911, pp 58) **Cross sections and thermonuclear reaction rates for alpha particle induced reactions on ^{39}K and ^{41}K.** Scott, A.F.; Hansper, V.Y.; Tims, S.G.; Tingwell, C.I.W.; Sargood, D.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40023 (INIS-mf—10911, pp 25) **Transient field strengths for high velocity ^{52}Cr ions.** Stuchbery, A.E. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40024 (INIS-mf—10911, pp 34) **Cross sections and thermonuclear reaction rates of alpha particle induced reactions on ^{45}Sc.** Hansper, V.Y.; Scott, A.F.; Tims, S.G.; Tingwell, C.I.W.; Sargood, D.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40025 (INIS-mf—10911, pp 43) **^{58}Ni(d,^{3}He)^{57}Co reaction at 80 MeV.** Banks, S.M.; Spicer, B.M.; Shute, G.G.; Reiner, K.; Wagner, G.J.; Nann, H.; Stephenson, E. (Melbourne Univ., Parkville, Australia; Tuebingen Univ., Germany, F.R.; Indiana Univ. Cyclotron Facility, Bloomington). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40026 **(UCID—21063) The excitation function for ^{48}V from tritons on natural titanium.** West, H.I. Jr.; Lanier, R.G.; Mustafa, M.G.; O'Brien, H. (Lawrence Livermore National Lab., CA (USA); Los Alamos National Lab., NM (USA)). 5 May 1987. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010548.

Natural titanium is used as a diagnostic charged particle detector in nuclear device tests making use of the proton and deuteron reactions, which produce vanadium 48 as a product. The presence of tritons in the reaction environment can also produce vanadium 48 from triton reactions on titanium 3, titanium 47 and titanium 48. Triton reaction cross sections for titanium have been measured so that corrections to the proton and deuteron diagnostic data can be accurately calculated. These measurements were made using the Van de Graaff at the Los Alamos National Laboratory.

40027 **Total scattering and γ-ray-production cross sections for few-MeV neutrons on ^{54}Fe.** Guenther, P.T.; Smith, D.L.; Smith, A.B.; Whalen, J.F. (Argonne National Lab., IL, USA). *Annals of Nuclear Energy;* **13**: No. 11, 601-610(1986).

Cross sections for the following neutron interactions were obtained for ^{54}Fe in the few-MeV incident-energy range with resolutions of 50-100 keV: total interaction from approx. 0.5 to 4 MeV, elastic scattering from 1.2 to 4 MeV, inelastic scattering from 2 to 4 MeV for excitation energies up to 3 MeV, and inelastic-scattering γ-ray production from 1.4 to 3.6 MeV for transitions corresponding to the de-excitation of levels up to 3 MeV. The results are mutually consistent within experimental errors. A spherical optical-statistical model describes the energy-averaged behavior of these experiments reasonably well, although slight evidence for direct-reaction strength is exhibited by the angular distributions of neutrons scattered to the 1.408 MeV, 2^+, level.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

40028 (INIS-mf—10911, pp 61) **Cross sections and thermonuclear reaction rates of alpha particle induced reactions on ^{59}Co.** Tims, S.G.; Hansper, V.Y.; Scott, A.F.; Tingwell, C.I.W.; Sargood, D.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40029 (INIS-mf—10911, pp 65) **Cross sections of proton induced reactions on some isotopes of nickel.** Tingwell, C.I.W.; Hansper, V.Y.; Scott, A.F.; Sevior, M.E.; Tims, S.G.; Sargood, D.G. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40030 **Decay of /sup 80/Zn: Implications for shell structure and r-process nucleosynthesis.** Winger, J.A.; Hill, J.C.; Wohn, F.K.; Moreh, R.; Gill, R.L.; Casten, R.F.; Warner, D.D.; Piotrowski, A.; Mach, H. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 2, 758-764(Aug 1987). Contract W-7405-ENG-82.

The decay of /sup 80/Zn to levels in /sup 80/Ga has been studied from mass-separated activity produced in the thermal neutron fission of /sup 235/U. Based on γ singles and coincidence measurements, 26 γ rays were placed in a level scheme for /sup 80/Ga with 13 excited states up to 2655 keV. The emission of a γ ray resulting from delayed neutron emission of /sup 80/Ga is also reported. The structure of the /sup 80/Ga level scheme is discussed. The properties of /sup 80/Zn and /sup 80/Ga reported here are of astrophysical interest for modeling the r process.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

40031 (INIS-mf—10911, pp 54) **Quadrupole moment of ^{136}Ba.** Rothschild, P.J.; Baxter, A.M.; Burnett, S.M.; Fewell, M.P.; Gyapong, G.J.; Spear, R.H. (Australian National Univ., Canberra; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40032 **First observation of a near-harmonic vibrational nucleus.** Aprahamian, A.; Brenner, D.S.; Casten, R.F.; Gill, R.L.; Piotrowski, A. (Clark University, Worcester, Massachusetts 01610). *Physical Review Letters;* **59**: No. 5, 535-538(3 Aug 1987).

Evidence is presented for five closely spaced states in /sup 118/Cd near E/sub ex/≅2 MeV, which are interpreted as a near-harmonic three-phonon quintuplet. Candidates for even higher-lying multiphonon states are also found. The experimental spectrum is compared with an anharmonic vibrator [or U(5) spectrum] and an interacting-boson-approximation calculation incorporating a two-particle, four-hole intruder configuration.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

40033 **(BNL—39981) Are there non-statistical effects in / sup 173/Yb(n,gamma)/sup 174/Yb?.** Pospisil, S.; Becvar, F.; Chrien, R.E.; Kopecky, J. (Brookhaven National Lab., Upton, NY (USA); Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska; Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni; Netherlands Energy Research Foundation, Petten). 1987. Contract AC02-76CH00016. 2p. (CONF-8708101—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012491.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

The resonance-averaged capture of neutrons in ^{173}Yb has been studied at energy of 2 keV. With a statistical significance of 99.5% an enhancement of E1-transition to the neutron 2QP levels in ^{174}Yb is observed. 8 refs.

40034 (INIS-mf—10911, pp 35) **Elastic scattering of ^{152}Eu and ^{154}Eu gamma rays.** Taylor, R.B.; Tenansomprasong, P.; Whittingham, I.B. (James Cook Univ. of North Queensland, Townsville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40035 (INIS-mf—10911, pp 81) **Shape coexistence in very neutron-deficient Pt isotopes.** Dracoulis, G.D.; Stuchbery, A.E.; Byrne, A.P.; Poletti, A.R.; Poletti, S.J.; Gerl, J.; Bark, R.A. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40036 (INIS-mf—10911, pp 87) **Small angle Compton scattering of ^{152}Eu and ^{154}Eu gamma rays.** Dow, J.; Hicks, G.C.; Taylor, R.B.; Whittingham, I.B. (James Cook Univ. of North Queensland, Townsville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40037 (INIS-mf—10911, pp 88) **Magnetic moments of excited states in the transitional nuclei ^{150}Sm and ^{152}Sm.** Byrne, A.P.; Stuchbery, A.E.; Bolotin, H.H.; Doran, C.E.; Weng, P.K. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40038 (INIS-mf—10911, pp 67) **Partial fusion reaction study with the crystal ball.** Yamada, H.; Sarantites, D.G.; Hamilton, J.H.; Maguir, C.F.; Robinson, R.L.; Halbert, M.L.; Hensley, D.C.; Rauch, V.; Auble, R.L.; Bertrand, F.E. (Melbourne Univ., Parkville, Australia; Washington Univ., St. Louis, MO; Vanderbilt Univ., Nashville, TN). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40039 **Superdeformed bands at high spin in Z = 66 and 68 isotopes.** de Voigt, M.J.A.; Bacelar, J.C.; Beck, E.M.; Deleplanque, M.A.; Diamond, R.M.; Draper, J.E.; Riezebos, H.J.; Stephens, F.S. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 3, 270-273(20 Jul 1987). Contract AC03-76SF00098.

The nucleus /sup 152/Dy, with sharp ridges in the γ-γ energy correlation matrix, stands out from three neighboring nuclei which exhibit less pronounced structures. The ridges include the observed discrete superdeformed band, but must be composed mainly of unresolved superdeformed bands, which decay predominantly to less deformed states. A simple decay model is proposed.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

40040 **(IKDA—86/27) Isoscalar quadrupole giant resonance in /sup 208/Pb: A statistical analysis of high-resolution inelastic electron scattering spectra.** Kilgus, G.; Knuepfer, W.; Kuehner, G.; Mueller, S.; Richter, A. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik; Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Theoretische Physik). Oct 1986. 29p. NTIS, PC E07; Available from NTIS as TIB/B87-10186.

The fine structure observed in high resolution inelastic electron scattering spectra for /sup 208/Pb in the excitation energy range of the isoscalar giant quadrupole resonance has been analysed with a fluctuation analysis technique. The obtained density of levels as a function of excitation energy E/sub x/ has then been used as a constraint for the shape and magnitude of the (radiative) background subtracted spectra subjected to a multipole decomposition. The derived E2 strength in the region 8.0 ≦ E/sub x/ ≦ 11.5 MeV exhausts (50/sub -7//sup +15/)% of the energy weighted sum rule. The E2 strength found is considerably larger than previously estimated from the same spectra and it is now both in shape

and magnitude in good agreement with results from a recent /sup 208/Pb(e,e'n) coincidence experiment.

40041 (INIS-mf—10911, pp 30) **Electric moments of some higher excited states of ^{194}Pt, ^{196}Pt, ^{198}Pt.** Fewell, M.P.; Gyapong, G.J.; Spear, R.H.; Baxter, A.M.; Burnett, S.M. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40042 (INIS-mf—10911, pp 51) **Quadrupole moments of the first excited states of ^{192}Pt, ^{194}Pt, ^{196}Pt.** Gyapong, G.J.; Spear, R.H.; Esat, M.T.; Fewell, M.P.; Baxter, A.M.; Burnett, S.M. (Australian National Univ., Canberra; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40043 (INIS-mf—10911, pp 57) **Valence configurations in ^{213}Rn.** Stuchbery, A.E.; Dracoulis, G.D.; Byrne, A.P.; Bark, R.A.; Poletti, A.R. (Australian National Univ., Canberra; Auckland Univ., New Zealand). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40044 (INIS-mf—10911, pp 66) **High spin states in ^{211}Fr, ^{212}Fr, ^{213}Fr.** Bryne, A.P.; Dracoulis, G.D.; Fahlander, C.; Hubel, H.; Poletti, A.R.; Stuchbery, A.E.; Gerl, J.; Davie, R.F.; Poletti, S.J. (Melbourne Univ., Parkville, Australia; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40045 (INIS-mf—10911, pp 71) **Low-lying states in even heavy-transitional (W, Os, Pt) nuclei.** Stuchbery, A.E. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40046 (INIS-mf—10911, pp 79) **First take your high spin orbitals and then construct ^{214}Rn.** Poletti, A.R.; Dracoulis, G.D.; Byrne, A.P.; Stuchbery, A.E. (Auckland Univ., New Zealand; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

40047 **(CONF-870410—29) What can we learn about fragmentation from coincidence experiments?.** Kaufman, S.B. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011426.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

It has become clear that in order to characterize a complex process such as nuclear fragmentation more exclusive experimental measurements must be performed, i.e., the correlations between coincident fragments must be determined. Some types of correlations are readily interpreted in terms of specific mechanisms, for example, the angular correlation between two heavy fragments. Binary (fission-like) breakup results in relatively strong angular correlations, while no strong correlations are expected for a multi-body fragmentation mechanism. Data from coincidence measurements of the fragmentation of uranium and gold targets by relativistic projectiles are presented which illustrate these points. The interplay between such experiments and model calculations of fragmentation is discussed. 19 refs., 9 figs.

40048 **(JAERI-M—86-116) Development of a nuclear spallation simulation code and calculations of primary spallation products.** Nishida, Takahiko; Nakahara, Yasuaki; Tsutsui, Tsuneo. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 71p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702518.

In order to make evaluations of computational models for the nuclear spallation reaction from a nuclear physics point of view, a simulation code NUCLEUS has been developed by modifying and combining the Monte Carlo codes NMTC/JAERI and NMTA/JAERI for calculating only the nuclear spallation reaction (intranuclear cascade + evaporation and/or fast fission) between a nucleus and a projectile without taking into consideration of internuclear transport. Several new plotting routines have been provided for the rapid process of much more event data, obtained by using the ARGUS plotting system. The results obtained by the code can be directly compared with the experimental results using by thin foil experiments in which internuclear multiple collisions have little effects, and will serve to upgrade the calculational methods and the values of nuclear parameters currently used in the calculations. Some discussions are done about the preliminary computational results obtained by using NUCLEUS. The mass distribution and charge dispersion of reaction products are examined in some detail for the nuclear spallation reaction between incident protons and target nuclei, such as U, Pb and Ag, in the energy range from 0.5 GeV to 3.0 GeV. These results show that the distribution of reaction products ceases to change its form as the proton energy increases over about 2 GeV. The same tendency is seen in the energy dependence of the number of primary particles emitted from a nucleus. After spallation reactions, a variety of nuclei, especially many neutron deficient nuclides with nuclear charges nearly equal to ones of a target nucleus, are produced. Due to their short lifetime most of them will change to stable nuclides in due time. Finally, some important issues are discussed to improve the present simulation method.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 39995, 40007, 40129, 40316, 40316

40049 **(CONF-8704178—1) Theoretical aspects of high-energy heavy-ion reactions.** Wong, Cheuk-Yin. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011147.

From 10. INS-Kikuchi spring school on quarks and nuclei; Shimoda, Japan (15 Apr 1987).

An elementary introduction is given to the subject of nucleus-nucleus collisions at high energies. It begins with a discussion on the relevant kinematic variables to establish the language for these collisions. It examines the question of particle production and the characteristics of the loss of baryon energy in an inelastic nucleon-nucleon collision. The geometrical aspect of a nucleus-nucleus collision is then described in terms of the Glauber multiple-collision model. As the theory of relativistic heavy-ion collision has not yet reached a stage whereby the dynamics can be examined from a fundamental theory, various phenomenological models have been proposed. The assumptions used in various models are described. Future use of relativistic heavy-ion collisions to study the quark-gluon plasma is briefly discussed.

40050 **(CONF-8706166—1) Nuclear stopping power in high-energy collisions.** Wong, Cheuk-Yin. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011643.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

We study the degree of nuclear stopping from the viewpoint of the slowing down of a nucleon as it passes through a nucleus. The analysis of the p + A → p + X data of Bailey shows that the degree of nuclear stopping is large. 21 refs., 4 figs.

40051 **(DOE/ER/40150—17) Relativistic equations.** Gross, F. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA); College of William and Mary, Williamsburg, VA (USA). Dept. of Physics). 1986. Contract AC05-84ER40150. 15p. (CEBAF-PR—86-011; CONF-8610196—6). NTIS MF A01; 2; GPO Dep. File Number DE87008665.

From European workshop on few body physics; Rome, Italy (7 Oct 1986).

Relativistic equations for two and three body scattering are discussed. Particular attention is paid to relativistic three body kinetics because of recent form factor measurements of the Helium 3 - Hydrogen 3 system recently completed at Saclay and Bates and the accompanying speculation that relativistic effects are important for understanding the three nucleon system. 16 refs., 4 figs.

40052 **(GSI—87-8-Prepr.) Dynamical and statistical aspects of intermediate energy heavy ion collisions.** Knoll, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1987. 26p. (CONF-861061—3-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-06361.

From International School of Heavy Ion Physics course on the response of nuclei under extreme conditions; Erice, Italy (12 Oct 1986).

The lectures presented deal with three different topics relevant for the discussion of nuclear collisions at medium to high energies. The first lecture concerns a subject of general interest, the description of statistical systems and their dynamics by the concept of missing information. If presents an excellent scope to formulate statistical theories in such a way that they carefully keep track of the known (relevant) information while maximizing the ignorance about the irrelevant, unknown information. The last two lectures deal with quite actual questions of intermediate energy heavy-ion collisions. These are the multi-fragmentation dynamics of highly excited nuclear systems, and the so called subthreshold particle production. All three subjects are self-contained, and can be read without the knowledge about the other ones.

40053 **(GSI—87-9-Prepr.) Collective azimuthal alignment in relativistic heavy ion reactions.** Beckmann, P.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.; Loehner, H.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R.; Siemiarczuk, T. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1987. 11p. NTIS, PC E07; Available from NTIS as TIB/B87-06360.

The collective azimuthal alignment of charged particles is observed inside of two groups of particles, one emitted to the backward and one emitted to the forward hemisphere in the centre of mass of symmetric heavy ion collisions. The alignment is more pronounced for larger masses of colliding nuclei and exhibits distinct multiplicity and energy dependence.

40054 **(GSI—87-12-Prepr.) Systematic study of the heavy-ion fusion barrier in the frozen approximation.** Berdichevsky, D.; Reisdorf, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Feb 1987. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-06363.

The height and position of the fusion barrier for the real part of the interaction potential between two colliding nuclei are studied as a function of the Coulomb strength. The calculations are performed in the framework of the spherical constrained HF + BCS formalism using the frozen approximation. The effective Skyrme type force SKa is used. The model contains no free parameters. For the height of the fusion barrier good agreement is found with the values obtained using the empirical Bass potential that is known to reproduce well the data for many nuclear systems. In contrast, the recently observed apparent rise of the fusion barrier ('extra-extra-push') for very massive nuclear systems with a product of nuclear charges Z/sub 1/xZ/sub 2/ above 1600 cannot be reproduced. We also give estimations for the overlap of the mass densities of both colliding nuclei at the fusion barrier distance.

40055 **(GSI—87-14-Prepr.) Contribution of collective zero-point motion to mean-square charge radii.** Myers, W.D.; Rozmej, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Feb 1987. 16p. NTIS, PC E07; Available from NTIS as TIB/B87-06362.

The contribution of collective quadrupole zero-point motion to changes in mean-square radii is calculated for transition nuclei in a long sequence of rubidium isotopes. The results of the calculation do not agree with the measured values. Some additional calculations are performed to show that the results are not sensitive to the choice of the collective inertial parameters.

40056 **(GSI—87-16-Prepr.) Recent results on alpha radioactivity.** Roeckl, E.; Schardt, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1987. 41p. NTIS, PC E07; Available from NTIS as TIB/B87-08668.

In this report, we describe recent results on direct (in contrast to β delayed) α radioactivity. (orig./HSI).

40057 **(IKDA—86/20) Excitation energy and transition strength systematics of mixed symmetric J/sup π/=1/sup +/ states from inelastic electron scattering.** Hartmann, U.; Bohle, D.; Guhr, T.; Hummel, K.D.; Kilgus, G.; Milkau, U.; Richter, A. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Aug 1986. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-10187.

The experimental systematics of the excitation energy of mixed symmetric J/sup π/=1/sup +/ states in /sup 46,48/Ti, /sup 110/Pd, /sup 154/Sm, /sup 154,156,158/Gd, /sup 164/Dy, /sup 168/Er, /sup 174/Yb, /sup 232/Th and /sup 238/U is compared with theoretical predictions. The emphasis is placed on a unified description in terms of the interacting boson model (IBM-2). The Majorana force parameter changes in a systematic way as a function of the product of active neutrons and protons participating in the collective motion. The systematics of the M1 strength distribution in the rare earth nuclei is also discussed. So far only the IBM-2 description using an F-spin invariant Majorana force is able to account for the trend of the data.

40058 (INIS-mf—10911, pp 41) **Sub-barrier fusion of the oxygen isotopes.** Thomas, J.; Chen, Y.T.; Hinds, S. (California Institute of Technology, Pasadena; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40059 (INIS-mf—10911, pp 22) **Role of pions in nuclei.** Afnan, I.R. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40060 (INIS-mf—10911, pp 27) **Phenomenological nucleon-nucleon interaction.** Berge, L.; Petris, L. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40061 (INIS-mf—10911, pp 64) **Renormalised π - NN coupling constant in the cloudy bag model.** Pearce, B.C.; Afnan, I.R. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40062 (INIS-mf—10911, pp 84) **Quasiparticles and IBA mappings.** Wood, L.D.; Morrison, I. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40063 (INIS-mf—10911, pp 70) **Field theory and potential approximations.** McKellar, B.H.J.; Warner, R.C. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40064 (INIS-mf—10911, pp 74) **Colour-dielectric model as an explanation of the Nolen-Schiffer anomaly.** Williams, A.G.; Thomas, A.W. (Adelaide Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40065 (INIS-mf—10911, pp 13) **Magnetic moments of short-lived excited nuclear states.** Bolotin, H.H. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40066 (INIS-mf—10911, pp 14) **Hadron models from QCD.** Roberts, C.D.; Cahill, R.T. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40067 (INIS-mf—10911, pp 17) **Chiral soliton model of the nucleon and delta.** Araki, M. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40068 (INIS-mf—10911, pp 21) **Renormalisation of g-boson effects in the interacting boson model.** Chen, Xue Jun; Morrison, I.; Amos, K. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40069 (INIS-mf—10911, pp 36) **Platinum-196 as a U(5) nucleus.** Fewell, M.P. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40070 (INIS-mf—10911, pp 63) **Quasiparticle states in the IBA.** Kuyucak, S. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40071 (INIS-mf—10911, pp 89) **Isospin mixing in the 1^-, 6.88 MeV level of ^{10}B.** Barker, F.C. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40072 (INIS-mf—10911, pp 93) **Transfer contribution to elastic $^{16}O + ^{20}Ne$ scattering and parity-dependent interactions.** Kondo, Y.; Robson, B.A.; Smith, R.; Wolter, H.H. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40073 (INIS-mf—10911, pp 15) **Microscopic optical potentials for nucleon and nucleus scattering.** Rikus, L. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40074 (INIS-mf—10911, pp 19) **Inelastic scattering to unnatural parity states in light nuclei using elementary probes.** Berge, L.; Amos, K. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40075 (INIS-mf—10911, pp 32) **Microscopic analyses of antiproton scattering in the analytic distorted wave approximation.** Di Marzio, F.; Amos, K.A. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40076 (INIS-mf—10911, pp 60) **Effects of collective excitations in the elastic scattering of vector polarized deuterons.** Nurzynski, J. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40077 (INIS-mf—10911, pp 75) **EMC effect and the smoking-gun.** Bickerstaff, R.P. (Adelaide Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40078 (INIS-mf—10911, pp 77) **Timescale of fusion-fission.** Hinde, D.J.; Foote, G.S.; Leigh, J.R.; Newton, J.O.; Charity, R.J.; Ogaza, S.; Chatterjee, A. (Australian National Univ., Canberra; Lawrence Berkeley Lab., CA; Institute of Nuclear Physics, Krakow, Poland; Bhabha Atomic Research Centre, Bombay, India). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40079 (INIS-mf—10911, pp 86) **Angular momentum distribution of the compound nucleus.** Kondo, Y.; Robson, B.A.; Bokhorst, J.J.M.; Hinde, D.J.; Leigh, J.R. (Australian National Univ., Canberra; Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40080 (INIS-mf—10911, pp 31) **Calculation of the energy spectrum of neutrons released in fission.** Walsh, R.L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40081 (INIS-mf—10911, pp 82) **Can we measure fission barriers?.** Leigh, J.R. (Australian National Univ., Canberra). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40082 (INIS-mf—10911, pp 91) **Neutron fission of ^{230}Th.** Boldeman, J.W.; Walsh, R.L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40083 (INS—564) **Mean square radius of the breathing mode.** Koo, W.K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1985. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702492.

From the results of energy weighted sum rules the difference in the mean square radius between the giant monopole state and that of the ground state is found to be <r²>/sub gg/-<r²>/sub 00/ ≃ 2A⁻²3/ fm².

40084 (INS—568) **Exchange currents in the neutrino-deuteron reactions and the solar neutrino problem.** Nozawa, Satoshi; Kohyama, Yasuharu; Kaneta, Tomohiro; Kubodera, Kuniharu. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702493.

The cross sections of the reactions nu/sub e/ + d -> e⁻ + p + p and nu-bar/sub e/ + d -> e⁺ + n + n are calculated with exchange currents taken into account. The relevance of the results to solar neutrino experiments is discussed.

40085 (INS—585) **Definite evidence of the Landau-Zener transition in nucleus-nucleus collisions.** Imanishi, B.; Oertzen, W. von; Voit, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702494.

It is shown that the Landau-Zener transition mechanism due to the formation of molecular orbitals of the active neutron exists in the inelastic scattering ^{13}C(^{12}C, ^{12}C)^{13}C* (3.086 MeV, 1/2⁺). The evidence stems from characteristic changes of the angular distributions observed as function of the incident energy.

40086 (INS—586) **Molecular orbitals of nucleons in nucleus-nucleus collisions.** Imanishi, B.; Oertzen, W. von. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1986. 249p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702495.

A formalism for the dynamical treatment of the molecular orbitals of valence nucleons in nucleus-nucleus collisions at low bombarding energy is developed with the use of the coupled-reaction-channel (CRC) method. The Coriolis coupling effects as well as the finite mass effects of the nucleon are taken into account in this model, of rotating molecular orbitals, RMO. First, the validity of the concept is examined from the view point of the multi-step processes in a standard CRC calculation for systems containing two identical [core] nuclei. The calculations show strong CRC effects particularly in the case where the mixing of different l-parity orbitals, called hybridization in atomic physics, occurs. Then, the RMO representation for active nucleons is applied to the same systems and compared to the CRC results. Its validity is investigated with respect to the radial motion (adiabaticity) and the rotation of the molecular axis (radial and rotational coupling). Characteristic molecular orbitals of covalent molecules appear as rotationally stable states (K = 1/2) with good adiabaticity. Using the RMO's we obtain a new interpretation of various scattering phenomena. Dynamically induced changes in the effective Q-values (or scaling of energies), dynamically induced moments of inertia and an dynamically induced effective (L center dot S) interaction are obtained as a result of the molecular orbital formation. Various experimental data on transfer and subbarrier fusion reactions are understood in terms of the RMO's and their adiabatic potentials. Landau-Zener transitions, which strongly depend on the total angular momentum of the system, definitely predict the observation of characteristic changes in the cross sections for the inelastic scattering ^{13}C(^{12}C, ^{12}C)^{13}C* (3.086 MeV, 1/2⁺) with the change of the bombarding energy. 110 references.

40087 (INS—592) **Collective, dissipative and stochastic motions in the TDHF theory.** Muramatsu, Kazuhiro; Yamamoto, Yoshifumi; Marumori, Toshio; Sakata, Fumihiko. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702497.

By applying the systematic microscopic theory of dynamical collective submanifold, which has been formulated by the present authors, to a system with a simple model Hamiltonian, characteristic features of large-amplitude motion described by the time dependent Hartree-Fock (TDHF) theory are visualized. The theory can dynamically define an optimum submanifold out of the TDHF symplectic manifold (phase space) in such a way that the Hamiltonian on the submanifold is stationary with respect to variations perpendicular to it. The theory can also classify the submanifold into three different regions by means of both stability and separability conditions. It is displayed that these three regions classified by the two conditions can characterize collective, dissipative, and stochastic motions in the TDHF theory.

40088 (LA-UR—87-782) **Hypernuclear physics.** Gibson, B.F. (Los Alamos National Lab., NM (USA); Melbourne Univ., Parkville (Australia). School of Physics). 1987. Contract W-7405-ENG-36. 26p. (CONF-870282—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007477.

From 8. summer school of nuclear and particle physics; Launceston, Australia (2 Feb 1987).

A brief overview of progress made in the study of hypernuclear physics is presented. The use of Λ-hypernuclei to study properties of conventional (nonstrange) nuclei is explored. Our knowledge of the hyperon-nucleon force is reviewed. Anecdotal examples of interesting hypernuclear phenomena are discussed. The status of Σ-hypernuclei is considered along with a search for the "H" dibaryon. 30 refs., 10 figs.

40089 (LA-UR—87-2127) **Pion charge-exchange reactions: The analog state transitions.** Baer, H.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 40p. (CONF-8704178—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011745.

From 10. INS-Kikuchi spring school on quarks and nuclei; Shimoda, Japan (15 Apr 1987).

The general features of pion charge-exchange reactions leading to nuclear-isobaric-analog states (IAS) and double-isobaric-analog states (DIAS), as they have emerged from studies over the past ten years, are reviewed. The energy range investigated is 20 to 550 MeV for IAS transitions and 20 to 300 MeV for DIAS transitions. These data are seen to play an important role in characterizing the pion optical potential, in determining the Δ-N interaction in nuclei, and in the study of nucleon correlations in nuclei. Recent progress achieved in understanding the role of such correlations in double-charge-exchange reactions is reviewed. 55 refs., 43 figs., 3 tabs.

40090 (RCNP-P—73) **Current puzzles in nuclear physics.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1985. 110p. (CONF-8406357—). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702544.

From Meeting on current puzzles in nuclear physics; Ibaraki, Japan (27 Jun 1984).

A meeting on "Current puzzles in nuclear physics" was held at Research Center for Nuclear Physics, Osaka University, on June 27-28, 1984. The meeting put emphasis on several puzzles which have not been solved for a long time in nuclear physics, and also on the puzzles. This collective report is composed of following eleven papers presented at the meeting. Almost all the papers are witten in English : (1) M1, GT excitations and configuration mixing (in Japanese). (2) Hadronic excitation of pionic states. (3) Microscopic analyses of /sup 28/Si(α,α')/sup 28/Si scattering and single particle strength in A = 29 nuclei. (4) Few-body physics and its incentives to nuclear physics. (5) Is it necessary to introduce three body interactions ? (in Japanese). (6) Puzzles in the neutron-deuteron elastic scattering. (7) Puzzles in NN, NΔ, πN and Nanti N interactions. (8) Problems in Hadron-Nucleus interaction. (9) Unified approach to the meson- and quark- theory of nuclear forces and currents. (10) Pion photoproduction in two Chiral bag models. (11) The dynamic bag model : The electromagnetic properties of nucleon. (Aoki, K.).

40091 **(RCNP-P—78) Workshop report on nuclear reaction and cluster structure.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1985. 131p. (In Japanese). (CONF-8406358—). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702548.

From Workshop on nuclear reaction and cluster structure; Ibaraki, Japan (25 Jun 1984).

A workshop was held in June 1984 at RCNP (Research Center for Nuclear Physics), Osaka University, to discuss theory of nuclear reactions based on studies from microscopic or cluster structure viewpoints. About forty researchers participated in this work shop and 27 paperes were presented. All these papers with English abstracts are gathered in this collective report. (Aoki, K.).

40092 **(RIFP—606) Structure of $^{12}C + ^{16}O$ molecular bands.** Kato, K.; Okabe, S.; Abe, Y. (Hokkaido Univ., Sapporo (Japan); Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). Jun 1985. 38p. NTIS, PC A03. File Number DE87900795.

$^{12}C+^{16}O$ molecule-like structure in the ^{28}Si system is studied by using a semi-microscopic $^{12}C+^{16}O$ cluster model. The effects of the Pauli principle on the relative motion between clusters are taken into account by employing of the orthogonality condition model. They play an important role in formation of the molecular configuration. A folding potential is used as an interaction between clusters with the inelastic excitation. The calculated energy spectra are very similar to the schematic diagram of the band crossing model (BCM). The properties of the molecular states are microscopically investigated and the validity of the phenomenological approach is also examined. 32 refs., 8 figs., 5 tabs.

40093 **Skyrmions with strangeness and nuclear matter.** Klebanov, I. (Joseph Henry Labs., Princeton Univ., Princeton, NJ 08544). pp 463-477 of Workshop on nuclear chromodynamics: Quarks and gluons in particles and nuclei. Brodsky, S.; Moniz, E. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8508127—).

From Nuclear chromodynamics: quarks and gluons in particles and nuclei; Santa Barbara, CA, USA (12 Aug 1985).

The author discusses two applications of the Skyrme model. Bound states of kaons and SU(2) skyrmions are used to describe strange baryons. A model of a cubic neutron crystal is constructed in terms of a multi-soliton configuration.

40094 **Color force saturation in nuclear chromodynamics.** Sivers, D. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). pp 322-327 of Workshop on nuclear chromodynamics: Quarks and gluons in particles and nuclei. Brodsky, S.; Moniz, E. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8508127—).

From Nuclear chromodynamics: quarks and gluons in particles and nuclei; Santa Barbara, CA, USA (12 Aug 1985).

A simple representation of the QQ-barQQ-bar Green's Function in the strong coupling quenched approximation to lattice QCD is used to illustrate the nature of color force saturation in chromodynamics. The example used shows that configuration mixing allows a binding energy of a few MeV in a QQ-barQQ-bar "molecule" formed from mesons with mass 1 GeV. In lattice QCD, configuration mixing can be calculated on the same footing with glueball exchange effects by measuring the appropriate operators in a Monte Carlo simulation.

40095 **The EMC effect today.** Jaffe, R.L. (Center for Theoretical Physics, Lab. for Nuclear Science, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 215-237 of Workshop on nuclear chromodynamics: Quarks and gluons in particles and nuclei. Brodsky, S.; Moniz, E. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8508127—).

From Nuclear chromodynamics: quarks and gluons in particles and nuclei; Santa Barbara, CA, USA (12 Aug 1985).

The author gives a brief overview of deep inelastic scattering from nuclear targets. The paper falls into four parts: 1. Data: 2. Rescaling: 3. Convolution: and 4. Shadowing. The present state of experimental data on deep inelastic lepton scattering from nuclear targets is summarized. The connection between the shape of the EMC effect and the space time description of quarks in nuclei is also mentioned.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 39481, 40013

40096 **(AAEC/E—633) Subroutine MLTGRD: a multigrid algorithm based on multiplicative correction and implicit non-stationary iteration.** Barry, J.M.; Pollard, J.P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702416.

A FORTRAN subroutine MLTGRD is provided to solve efficiently the large systems of linear equations arising from a five-point finite difference discretisation of some elliptic partial differential equations. MLTGRD is a multigrid algorithm which provides multiplicative correction to iterative solution estimates from successively reduced systems of linear equations. It uses the method of implicit non-stationary iteration for all grid levels.

40097 **(AAEC/E—634) Implicit iterative scheme for solving large systems of linear equations.** Barry, J.M.; Pollard, J.P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702417.

An implicit iterative scheme for the solution of large systems of linear equations arising from neutron diffusion studies is presented. The method is applied to three-dimensional reactor studies and its performance is compared with alternative iterative approaches.

40098 **(AD-A—179743/0/XAB) Electromagnetic environmental criteria for US Army missile systems: EMC (electromagnetic compatibility), EMR (electromagnetic radiation), EMI (electromagnetic interference), EMP (electromagnetic pulse), ESD (electrostatic discharge), and lightning. Final report for period ending October 1986.** Kilpatrick, M.; Ponds, C.D. (Army Missile Command, Redstone Arsenal, AL (USA). Test and Evaluation Directorate). Feb 1987. 62p. (AMSMI/TR-RD-TE—87-1). NTIS, PC A04/MF A01.

This report presents the design and test requirements in developing an electromagnetic compatibility missile system. Environmental levels are presented for electromagnetic radiation hazards, electromagnetic radiation operational electrostatic discharge, lightning, and electromagnetic pulse (nuclear). Testing techniques and facility capabilities are presented for research and development testing of missile systems.

40099 **(DEMO—85/4) Exact formalism for Doppler-broadened neutron cross-sections.** Catsaros, N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jul 1985. 26p. NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC. File Number DE87702433.

An exact formalism (PSI, PHI) is proposed for the calculation of Breit-Wigner or Adler-Adler Doppler-broadened neutron cross-sections. The well-known (PSI, PHI) formalism is shown to be a zero-order approximation of the generalized (PSI, PHI) formalism.

40100 **(DOE/OR/00033—T323) Report of the CIRRPC Policy Subpanel on SI metric radiation units.** (Committee on Interagency Radiation Research and Policy Coordination, Washington, DC (USA)). Dec 1986. Contract AC05-76OR00033. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012619.

Recognizing that use of the International System of Units (SI) for radiological quantities is increasing internationally but is not currently widely accepted in the United States, and recognizing that the existing US policy is to plan for the increasing voluntary use of SI units domestically, it is recommended that it be US policy to use dual radiation units in Federal activities. However, it is recognized that in certain operational situations, by reason of economy or safety, the utilization of dual units is undesirable. Therefore, in justified situations, agencies may adopt that system of units which best meets their needs. The objective of the recommended use of dual units is primarily to familiarize people with the SI units. This should serve to ease transition when and where transition is appropriate and mitigate economic and safety concerns. The Subpanel has made suggestions on how this policy should be implemented by Federal agencies: using dual units in issuing regulations containing radiation units, except where determined to be impractical, incorporating dual units in agency internal operating procedures as they are written or revised; and using dual units in contracts and procurement. The Subpanel recommends that this policy be reexamined in about five years following an assessment of the use of SI radiation units both internationally and within the United States. 11 refs.

40101 **(INIS-mf—10630) Shielding practice. From 25 years' experience (1960-1985).** Sauermann, P.F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie). Aug 1985. 183p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-06248.

The basis of shielding practice against external irradiation is shown in a simple way. For most sources of radiation (point sources) occurring in shielding practice, the basic data are given, mainly in the form of tables, which are required to solve the shielding problems. The application of these data is explained and discussed using practical examples. Thickness of shielding panes of glove boxes for α and β radiation; shielding of sealed γ-radiography sources; shielding of a Co-60 radiation source, and of the manipulator panels for hot cells; damping factors for γ radiation and neutrons; shielding of fast and thermal neutrons, and of bremsstrahlung (X-ray tubes, Kr-85 pressure gas cylinders, 42 MeV betatrons, 20 MeV linacs); two-fold shielding (lead glass windows for hot cells, 14 MeV neutron generators); shielding against scattered radiation.

40102 (INIS-mf—10911, pp 18) **Transport theory for nuclear systems.** Weigel, M.K. (Muenchen Univ., Germany, F.R.). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40103 (INIS-mf—10911, pp 40) **Topological effects in neutron optics.** Klein, A.G.; Opat, G.I.; Cimmino, A. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40104 (INIS-mf—10911, pp 69) **Direct calculation of neutron damage from activation integrals.** Lang, D.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40105 (INIS-mf—10911, pp 85) **NEUGAT system - experiments on composition using simultaneous neutron and gamma transmission in solids.** Bartle, C.M. (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40106 **(JAERI-M—86-071) Applicability of geometrical progression approximation (G-P method) of gamma-ray buildup factors.** Harima, Yoshiko; Sakamoto, Yukio; Tanaka, Shun-ichi. (Japan Atomic Energy Research Inst., Tokyo). May 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702509.

The G-P method formula B/sub r/ (X) = 1 + (B-1) center dot (K/sup X/-1)/(K-1) (X: optical length, B: buildup factor at X = 1, K: a gamma-ray multiplication factor per one mean free path) gives an accurate representation of the buildup factor for point isotropic sources. In the present work, a fitting procedure has been developed including a new expression for K-parameter. The method is used for fitting to the buildup factors calculated by the moments method and by the PALLAS code. It improves agreement with the basic buildup factors calculated by the moments method, of air, water, concrete, and iron for the 0.015- to 15 MeV energy range and for the 0.5- to 40-mfp distance range. Furthermore, exposure, absorbed dose, and dose equivalent buildup factor approximated by the G-P fitting parameters are in good agreement with the basic data calculated by the PALLAS code, for water, concrete, iron, and lead. Good agreement is obtained even in the case of rapidly increasing buildup factors for low source energies in beryllium and boron and of that in lead, including the effects of bremsstrahlung and fluorescence. Furthermore, the G-P formula efficacy for use as an analysis and interpolation technique has been confirmed through the various tests for energetic or spatial interpolation.

40107 **(KFK—4163) GANTRAS - a system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry.** Schwenk-Ferrero, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Nov 1986. 114p. NTIS, PC E11; Available from NTIS as TIB/B87-06359.

GANTRAS is a system of codes for neutron transport calculations in which the anisotropy of elastic and inelastic (including (n,n'x)-reactions) scattering is fully taken into account. This is achieved by employing a rigorous method, so-called I/sup */-method, to represent the scattering term of the transport equation and with the use of double-differential cross-sections for the description of the emission of secondary neutrons. The I/sup */-method was incorporated into the conventional transport code ONETRAN. The ONETRAN subroutines were modified for the new purpose. An implementation of the updated version ANTRA1 was accomplished for plane and spherical geometry. ANTRA1 was included in GANTRAS and linked to another modules which prepare angle-dependent transfer matrices. The GANTRAS code consists of three modules: 1. The CROMIX code which calculates the macroscopic transfer matrices for mixtures on the base of microscopic nuclide-dependent data. 2. The ATP code which generates discretized angular transfer probabilities (i.e. discretizes the I/sup */-function). 3. The ANTRA1 code to perform S/sub N/ transport calculations in one-dimensional plane and spherical geometries. This structure of GANTRAS allows to accommodate the system to various transport problems.

6550 Medical Physics

REFER ALSO TO CITATION(S) 38948, 38982, 39677

40108 (BARC—1317) Computerised model for the calculation of the activity to dose conversion factor for radon daughter inhalation in dwellings. Muraleedharan, T.S.; Ramachandran, T.V.; Subba Ramu, M.C. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702428.

Occupants of dwellings are exposed to high concentrations of airborne radon and its daughters and hence it is important to assess the dose received by them. This report describes the various parameters that are used to calculate the dose to the lung. The calculations are carried out by a simple computer model with the help of which one can get the activity to dose conversion factor in terms of either rad or grey per working level month. Typical calculations have been carried out to show that the conversion factor can vary by a factor of 5 depending on some typical input parameters. 12 references, 4 figures.

40109 (INIS-BR—626) Industrial radioactive source: determination of the isodose curves. Caldas, L.V.E.; David, J. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8609282—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702461.

From 1. non destructive testing congress for Latin America and Caribbe; Sao Paulo, Brazil (21 Sep 1986).

Published in summary form only.

40110 (INIS-BR—651, pp 3) Silica exposure and alveolar epithelium permeability in personnels of ceramic industry. Martins, L.R.F.; Nery, L.E.; Sandoval, P.R.M.; Jardim, J.R.B.; Bagatim, E.; Alonso, G. (Escola Paulista de Medicina, Sao Paulo, Brazil; Laboratorio Fleury, Sao Paulo, Brazil). 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

40111 (INIS-mf—10895) Organization of internal contamination monitoring. Badreddine, A. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Jul 1986. 93p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702487.

Nuclear energy takes a big part in the world's energy production. The nuclear techniques are used in most fields of life. Nevertheless the use of radioactive materials may cause prejudice to human beings by radiation contamination. The International Commission on Radiological Protection gives the general rules and regulations to avoid this danger. In the publication No. 30, the ICRP gives a metabolic model for the respiratory system and values of annual limit of intake (ALI). The ALI for inhalation supposes a standard AMAD (Activity Median Aerodynamic Diameter) of 1 um. The authors have measured the AMAD in a laboratory under different conditions of functioning in order to show its variation. Then the effect of this variation on the internal contamination monitoring was analyzed. Thus the effective committed dose (ECD), the ALI, then the derived investigation level (DIL) were calculated for different values of AMAD for whole-body counting (WBC).

40112 Continuous three-dimensional radiation dosimetry in tissue-equivalent phantoms using electron paramagnetic resonance in L-α-alanine. Wielopolski, L.; Maryanski, M.; Ciesielski, B.; Forman, A.; Reinstein, L.E.; Meek, A.G. (Brookhaven National Laboratory, Medical Department, Upton, New York 11973). *Medical Physics;* **14**: No. 4, 646-652(Jul 1987). Contract AC02-76CH00016.

A new tissue-equivalent phantom material has been developed which also acts as a dosimeter. The new phantom material has a similar elemental composition to that of soft tissue and has a density 1.1 g/cm^3. The phantom has an agar-gel base, and contains crystallized L-α-alanine which traps radiation-induced free radicals. Samples from the phantom were analyzed by an electron paramagnetic resonance (EPR) spectrometer and the intensity of the EPR signal was related to the absorbed dose. When calibrated, the phantom material acts as a dosimeter, with applications in radiation therapy.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 39210, 39350, 39363, 40287

40113 (CONF-870873—9) Single particle dynamics in the Anderson lattice. Fedro, A.J.; Dunlap, B.D. (Argonne National Lab., IL (USA); Northern Illinois Univ., Dekalb (USA)). May 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02. File Number DE87011389.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

A theory is presented for the single particle dynamics of the $U \rightarrow \infty$ Anderson lattice using a projection operator which projects out of any operator its exact thermal average in the space of single particle excitations and is capable of handling the complex f statistics properly. It is exact in the large degeneracy limit and gives a dynamically renormalized hybridization and f level energy. In addition, we find self-energy corrections from the on-site c-f exchange and intersite RKKY exchange induced by the correlation which are absent in other truncation treatments and lead to competition between on-site screening and magnetic effects.

40114 (DOE/ER/13641—1) Thinning and rupture of a thin liquid film on a horizontal heated solid surface: Progress report for period 9/15/86-6/15/87. Bankoff, S.G.; Davis, S.H. (Northwestern Univ., Evanston, IL (USA)). Jun 1987. Contract FG02-86ER13641. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011931.

The governing equations for the nonlinear stability and rupture of a thin liquid film lying on a heated horizontal solid surface have been derived and solved. Using lubrication theory, a general evolution equation has been obtained which takes into account the effects of van der Waals forces, surface thermal evaporative resistance, mass loss by evaporation, surface vapor recoil, thermocapillary effects due to temperature gradients normal and parallel to the heated surface, surface tension and/or gravitational effects. Numerical results, obtained for a number of special cases, show that rupture times can be of the order of microseconds, once van der Waals forces are effective. An experiment is being designed to measure the thickness of a non-uniformity heated film by optical methods.

40115 (INIS-BR—624) Purification and growth of LiF by induction heating furnace with electronic temperature control. Faria Junior, R.N. de. (Sao Paulo Univ. (Brazil)). 1985. 102p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702460.

An eletronic power control system for a radio frequency generator and a quartz vacuum furnace heated by induction were developed. This furnace was employed for the growth of single crystals and purification of starting materials. A lithium fluoride single crystal was grown by the Czochralski technique in order to test the temperature control and the quartz furnace. An X-ray diffraction analysis of the crystal revealed the monocrystallinity and high optical quality of the crystal obtained. Lithium fluoride of 95% purity prepared by Nuclemon starting material was purified by a vertical Bridgmann method. The emission spectrographic analysis of the purified crystal demonstrated the segregation of impurities. This study showed that the purification by this method of starting materials produced by local industry resulted in a crystal 99.9% pure in the first crystallization.

40116 (LA-UR—87-2228) Vibrational spectroscopy of shock-compressed fluid N_2 and O_2. Schmidt, S.C.; Moore, D.S.; Shaw, M.S.; Johnson, J.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-870754—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011730.

From 11. international AIRAPT conference; Kiev, USSR (12 Jul 1987).

Single-pulse multiplex coherent anti-Stokes Raman scattering (CARS) was used to observe the vibrational spectra of liquid N_2 shock-compressed to several pressures and temperatures up to 41 GPa and 5200 K and liquid O_2 shock-compressed to several pressures and temperatures up to 10 GPa and 1000 K. For N_2, the experimental spectra were compared to synthetic spectra calculated using a semiclassical model for CARS intensities and estimated vibrational frequencies, peak Raman susceptibilities, and Raman line widths. The question of excited state populations in the shock-compressed state is addressed.

40117 **(LA-UR—87-2233) Birch's Law for fluid metals.** Shaner, J.W.; Hixson, R.S.; Winkler, M.A.; Boness, D.A.; Brown, J.M. (Los Alamos National Lab., NM (USA); Washington Univ., Seattle (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—7). NTIS, PC A02. File Number DE87011729.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

By comparing acoustic velocities in fluid metals over a very wide range of densities we have established Birch's Law as an approximate representation over the entire liquid range. For a given liquid metal the acoustic velocity is close to linear in density, with a slope determined by the atomic weight. The measurements include isobaric expansion to less than half normal density, ultrasonics on molten metals at 1 atmosphere, and shock melted metals to greater than twice normal density.

40118 **(SAND—87-0773C) A numerical study of Rayleigh-Taylor instability in solids.** Swegle, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870753—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011319.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

In an effort to better understand the phenomenon of the growth of Rayleigh-Taylor instabilities in solids, a numerical study using a Lagrangian finite-difference wavecode has been done to determine the influence of various parameters including perturbation amplitude and wavelength, material yield strength, and driving pressure history. Results have been correlated with experimental data on aluminum, and with current analytical modeling efforts. More complex behavior is seen than predicted by earlier analytical treatments found in the literature. Rather than simple stability criteria based amplitude or wavelength alone, it is found that there are yield strength and driving pressure dependent boundaries between stable and unstable regions in the amplitude-wavelength plane. Also, different behavior is seen for increasing driving pressure than for constant driving pressure.

40119 **Noise tolerance of frequency-locked dynamics.** Wiesenfeld, K.; Satija, I. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **36**: No. 5, 2483-2492(15 Aug 1987).

We study the effect of noise on systems having two competing frequencies. In a mode-locked state, random perturbations are effectively suppressed, while outside a locking interval relatively high levels of broadband noise are observed, a correspondence first noted in experiments on charge-density waves. This correspondence is a general phenomenon and can be understood by simple dynamical considerations, as illustrated by the noisy circle map. We compare our analytic results for the observed power spectrum with digital simulations, and suggest tests of the theory for future experiments.

40120 **Crystal-field splitting in icosahedral symmetry.** Walter, U. (Materials Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439 and Department of Physics, University of California, Berkeley, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 5, 2504-2512(15 Aug 1987). Contract W-31-109-ENG-38.

The crystal-field splitting of rare-earth ions in icosahedral symmetry is treated by group-theoretical and numerical methods. From the crystal-field Hamiltonian, which is governed by only one crystal-field parameter, the crystal-field splitting schemes of all rare-earth ions in their Hund's-rule ground state are derived. It is shown that these schemes are expected to survive in quasicrystals as well as in metallic glasses. The derived temperature dependence of the surplus static susceptibility and specific heat, as generated by the icosahedral crystal-field splitting, is discussed and plotted for selected cases.

40121 **Altshuler-Aronov anomalies in the density of states of substitutional alloys.** Vignale, G.; Hanke, W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **36**: No. 5, 2924-2927(15 Aug 1987).

We calculate the density of states of interacting electrons in a tight-binding lattice with substitutional disorder. The random potential is not assumed to be small and it is therefore treated in the coherent-potential approximation. We find that the anomalous behavior of the density of states near the Fermi energy (—chemical bondE-E/sub F/chemical bond/sup 1/2/) is still described by the Altshuler-Aronov formula, although that formula was derived in the limit of a homogeneous electron gas with weak impurity scattering. The cancellation of band-structure and strong-scattering effects within our model is explicitly demonstrated. This provides strong evidence for the universality of the Altshuler-Aronov result in disordered metals.

40122 **Raman scattering from fractal structures.** Keyes, T.; Ohtsuki, T. (Department of Chemistry, Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **59**: No. 5, 603-603(3 Aug 1987).

A Comment on the Leter by A. Boukenter et al., Phys. Rev. Lett. 57, 2391 (1986).

40123 **Use of thermodynamic models in the prediction of the glass-forming range of binary alloys.** Schwarz, R.B.; Nash, P.; Turnbull, D. (Center for Materials Science, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* **2**: No. 4, 456-460(Jul 1987).

Analytical expressions describing the various thermodynamic phases in binary systems can be derived by the CALPHAD approach, whereby the parameters in these expressions are obtained from fits to measured phase equilibrium data. Extrapolations of these models can be used to predict metastable equilibria. Different thermodynamic models proposed for the Ni—Ti and the Cu—Ti systems are used to calculate the T_0 curves that are relevant to the prediction of the glass-forming range in rapidly cooled molten alloys. Although all the models give acceptable fits for the equilibrium range for which they were derived, significant differences are found for the metastable regime. The problems that need to be addressed in order to improve the extrapolations into the metastable regime are discussed. Simple thermodynamic considerations predict that the glass-forming range for rapidly quenched alloys exceeds that for amorphous alloys synthesized by isothermal solid-state interdiffusion reactions.

40124 **Muon bonding versus muonium formation: muon spin relaxation in α-Al_2O_3.** Boekema, C.; Chan, K.C.; Lichti, R.L.; Denison, A.B.; Cooke, D.W.; Heffner, R.H.; Hutson, R.L.; Schillaci, M.E. (San Jose State Univ., CA; Texas Tech Univ., Lubbock; Wyoming Univ., Laramie; Los Alamos National Lab., NM). *Hyperfine Interactions;* **32**: No. 1-4, 667-675(Dec 1986). (CONF-8606134—).

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (1 Jun 1986).

Results of muon-spin-relaxation (μSR) experiments on well-defined single crystals of corundum (α-Al_2O_3) are reported. Major issue in this study is the controversy of muon bonding or muonium formation in insulators. Transverse, zero-field and longitudinal-field measurements were performed as a function of temperature or applied field. The obtained results indicate that muon-oxygen bonding occurs in α-Al_2O_3, having (at least) two $(\mu O)^-$ states as found earli-

er for α-Fe_2O_3. The occurrence of a 10% missing fraction suggests Mu states, although Mu was not observed in the measurements. These results and their implications are discussed in light of other experimental μSR studies on insulating oxides and the above-mentioned controversy.

40125 Muon channeling in Ge: evidence for pionium formation. Flik, G.; Bradbury, J.N.; Cooke, D.W.; Heffner, R.H.; Leon, M.; Paciotti, M.A.; Schillaci, M.E.; Maier, K.; Rempp, H.; Boekema, C. (Los Alamos National Lab., NM; Max-Planck-Institut fuer Metallforschung, Stuttgart, Germany, F.R.; Stuttgart Univ., Germany, F.R.; San Jose State Univ., CA). *Hyperfine Interactions;* **32**: No. 1-4, 595-600(Dec 1986). (CONF-8606134—).

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (1 Jun 1986).

Also published as report LA-UR—86-2158; CONF—8606134-3.

In a recent experiment observing muon channeling from the decay of positive pions implanted in high-purity Ge single crystals, the pion decay site is found to be sensitive to the concentration of excess charge carriers produced by photon absorption. Distinctly different channeling profiles are observed in Ge at 100 K for illuminated samples (high carrier concentration) as compared to unilluminated samples (low carrier concentration). From these data, the authors conclude that different electronic states of the pion in a semiconductor host lattice must account for the observed changes in the pion location. Furthermore, they suggest that the pion exists in the solid both as the bare entity π^+ and as pionium (π^+e^-), i.e., a hydrogen-like atom with a mesonic nucleus.

6561 Superconductivity

REFER ALSO TO CITATION(S) 39215, 39216, 39224, 39236, 39240, 39241, 39242, 39243, 39257

40126 (BARC—1315) Facility for vacuum impregnation of superconducting magnets. Kush, P.; Banerjee, A.; Ramachandran, C.K.; Bapna, S.C.; Thirumaleshwar, M. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702426.

Facility for vacuum impregnation is developed specifically for the construction of superconducting magnets. Various methods of impregnation for superconducting magnet are described. This facility can be used for large coil of dimensions up to 45 cm. diagonally and weighing - 25 kg. The curing of the coil can be performed at any temperature up to 200degC. Performance of the facility is shown in the photographs of test coils with and without impregnation.

40127 (LA-UR—87-1418) Comparison of domain growth kinetics in two and three dimensions. Grest, G.S.; Anderson, M.P.; Srolovitz, D.J. (Exxon Research and Engineering Co., Annandale, NJ (USA). Corporate Research Science Lab.; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 24p. (CONF-8703118—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009011.

From NATO advanced study institute conference on time dependent effects in disordered materials; Geilo, Norway (29 Mar 1987).

Recent progress is reported in the understanding of the kinetics of domain growth for the Potts model and its connection to experiment. (WRF)

6570 Theoretical And Mathematical Physics

40128 (DOE/ER/40200—094) Cross-polarization in laser beams. Simon, R.; Sudarshan, E.C.G.; Mukunda, N. (Texas Univ., Austin (USA). Center for Particle Theory; Institute of Mathematical Sciences, Madras (India); Indian Inst. of Science, Bangalore. Centre for Theoretical Studies). Mar 1987. Contract FG05-85ER40200. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010916.

Polarization properties of Gaussian laser beams are analysed in a manner consistent with the Maxwell equations, and expressions are developed for all components of the electric and magnetic field vectors in the beam. It is shown that the transverse nature of the free electromagnetic field demands a non-zero transverse cross-polarization component in addition to the well-known component of the field vectors along the beam axis. The strength of these components in relation to the strength of the principal polarization component is established. It is further shown that the integrated strengths of these components over a transverse plane are invariants of the propagation process. It is suggested that cross-polarization measurement using a null detector can serve as a new method for accurate determination of the center of Gaussian laser beams.

40129 (INIS-mf—10911, pp 55) L^2 solution of the Schrodinger equation with a separable potential. Slim, H.A.; Stelbovics, A.T. (Murdoch Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40130 (INIS-mf—10911, pp 29) Applications of octonion algebra to ten dimensional space-time. Davies, A.J.; Joshi, G.C. (Melbourne Univ., Parkville, Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702489. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

40131 (LA-UR—87-156) Kinetic and fluid theory of microwave breakdown in air. Roussel-Dupre, R.A.; Murphy, T.; Johnson, A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870723—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005104.

From 18. international conference on phenomena in ionized gases; Swansea, UK (13 Jul 1987).

We have developed time-dependent fluid and kinetic treatments of electron transport in air in the presence of a propagating microwave pulse. In both cases the HPM pulses are assumed to be of short enough duration so that electron spatial diffusion can be neglected. In addition, we limit our calculations to the non-relativistic regime where effects due to the ponderomotive force are negligible. 6 refs., 4 figs.

40132 Modeling 1/f noise via dynamical random networks. Zhang, Y.; Liang, S. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2345-2348(1 Aug 1987).

We study 1/f noise using conducting networks whose random resistances are dictated by the underlying random spin dynamics. In our Monte Carlo simulations, the power spectra of the current fluctuations are calculated, and an approximate 1/f behavior observed. We study the noise amplitude in various circumstances (different temperatures, samples, annealing and quenching). Our findings suggest that metastable states are responsible for the 1/f behavior.

40133 Resolution of Loschmidt's paradox: The origin of irreversible behavior in reversible atomistic dynamics. Holian, B.L.; Hoover, W.G.; Posch, H.A. (Theoretical Division, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 1, 10-13(6 Jul 1987). Contract W-7405-ENG-36;W-7405-ENG-48.

We show that Nosromane-bar mechanics provides a link between computer simulations of nonequilibrium processes and real-world experiments. Reversible Nose-bar equations of motion, when used to constrain non- equilibrium boundary regions, generate stable dissipative behavior within an adjoining bulk sample governed by Newton's equations of motion. Thus, irreversible behavior consistent with the second law of thermodynamics arises from completely reversible microscopic motion. Loschmidt's reversibility paradox is surmounted by this Nose-bar-Newton system, because

the steady-state nonequilibrium probability density in the many-body phase space is confined to a zero-volume attractor.

40134 **Novel decomposition of the multichannel scattering matrix at resonances.** Gazdy, B.; Bowman, J.M. (Department of Chemistry, Emory University, Atlanta, Georgia 30322). *Physical Review Letters;* 59: No. 1, 3-5(6 Jul 1987).

A new decomposition of the multichannel scattering matrix, valid near an isolated, narrow resonance, is presented. It is consistent with the theory of single-channel resonances, and readily provides transition probabilities for inelastic resonant collisions. Some features of the formalism are illustrated by a vibration-rotation resonance in three-dimensional H + CO.

40135 **Pulse propagation in resonant media with lateral boundaries.** Prasad, S. (Center for Advanced Studies and Dept. of Physics and Astronomy, Univ. of New Mexico, Albuquerque, NM 87131). pp 303-313 of Coherence, cooperation and fluctuations. Haake, F.; Narducci, L.M.; Walls, D.F. New York, NY; Cambridge University Press (1985). (CONF-8510395—).

From Symposium in honor of Roy J. Glauber, Harvard University: coherence, cooperation and fluctuations; Cambridge, MA, USA (19 Oct 1985).

Sample boundaries parallel to the direction of propagation of a resonant pulse can create surface waves that interfere with the bulk response of the sample and thereby alter the nature of radiation, especially near these boundaries. This is demonstrated here for a rectangular sample geometry.

40136 **Cosmology and GUTs.** Olive, K.A. (Astrophysics Theory Group, Fermi National Accelerator Lab., Batavia, IL 60510). pp 347-419 of Grand unification with and without supersymmetry cosmological implications. Kounnas, C.; Masiero, A.; Nanopoulos, D.U.; Olive, K.A. Teaneck, NJ; World Scientific Pub. Co. (1984).

This paper contains an in-depth expose of the present status of the Big Bang Cosmology (BBC) and its correlations to particle physics. It includes the standard arguments which established BBC, its problems and their possible resolution in a GUT and inflation framework, as well as the importance and central role of supersymmetry and supergravity in all this cosmo-particle programme.

40137 **An obstacle to predictability.** Mc Donald, S.W.; Grebogi, C.; Ott, E.; Yorke, J.A. (Univ. of Maryland, College Park, MD). pp 71-74 of Group theoretical methods in physics. Zachary, W.W. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8405168—).

From International colloquium on group theoretical methods in physics; College Park, MD, USA (21 May 1984).

Typical nonlinear dynamical systems may have more than one time-asymptotic final state. In this paper the authors consider the extent to which uncertainty in initial conditions leads to uncertainty in the final state.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 40183, 40223

40138 **(DEMO—85/8) Conceptual design of a Langmuir probe system for the tokamak ASDEX-UPGRADE.** Anastassiadis, A.; Tsingas, A.C.; Tsois, N.N.; Zoumbos, G.A. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). May 1985. 111p. NTIS (US Sales Only), PC A06/MF A01 - Library, Democritus NRC. File Number DE87702436.

The conceptual design of a Langmuir probe system for the tokamak ASDEX-UPG is presented. This system is intended to carry out electrostatic measurements, in space and time, on the boundary layer plasma over the largest possible volume of the divertor plasma during discharges. Conducted by preset design requirements a fast probe system is proposed. During discharges signal measurements will be performed by means of a data-acquisition system and the motion will be controlled by a real-time computer. The desired information concerning plasma parameters and the motion of the probe system will be available to the diagnostician via a video display unit.

40139 **(DOE/ER/53223—32) Plasma diffusion and relaxation due to low-level turbulence.** Hameiri, E. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Mar 1987. Contract FG02-86ER53223. 39p. (MF—114; CONF-870359—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011088.

From 5. seminar on magnetohydrodynamic flows and turbulence; Jerusalem, Israel (2 Mar 1987).

A theory of low-level turbulence in compressible plasmas is presented. It is characterized by a separation of scales between the mean fields and the fluctuations, which are of low amplitude. Use of conservation laws of the system enables the derivation of important factors in the functional form of the turbulent diffusivity coefficients. In particular, it is shown that turbulent heat conductivity, like its molecular couterpart, transports heat in the direction opposite to the mean temperature gradient. The turbulent resistivity, on the other hand, acts non-classically and causes flattening of the parallel current profile so that the plasma tends to approach a "Taylor state." The case of planar, viscous, fluid flow is treated in detail as a special example. It is shown that turbulent viscosity in the low-level turbulence case simply causes enhancement of the molecular viscosity.

40140 **(DOE/ER/53223—33) A self-consistent electric field for Monte Carlo transport.** Garabedian, P.R. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1987. Contract FG02-86ER53223. 3p. (CONF-870947—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009344.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

The BETA transport code implements a Monte Carlo method to calculate ion and electron confinement times tau/sub i/ and tau/sub e/ for stellarator equilibria defined by the BETA equilibrium code. The magnetic field strength is represented by a double Fourier series in poloidal and toroidal angles psi and phi with coefficients depending on the toroidal flux s. A linearized drift kinetic equation determining the distribution functions of the ions and electrons is solved by a method of split time using an Adams ordinary differential equation algorithm to trace orbits and using a random walk to model the Fokker-Planck collision operator. Confinement times are estimated from exponential decay of expected values of the solution. Expected values of trigonometric functions of psi and phi serve to specify Fourier coefficients of an average over velocity space of the distribution functions.

40141 **(DOE/ER/53223—34) Magnetic surfaces and neoclassical transport in stellarators.** Ng, K.C. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Jun 1987. Contract FG02-86ER53223. 137p. (MF—115). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011280.

This paper studies the structure of a stellarator field and the confinement of a high temperature plasma in toroidal geometry. A field line tracing program is developed to explore the structure of magnetic fields on a fine scale so as to explain anomalous electron transport. The model magnetic field chosen has a simple analytic representation which is easy to compute, so that the field lines can be integrated to a high accuracy. In a typical case most of the magnetic surfaces are well behaved on the scale of the gyroradius of the electron, rho/sub e/, even when the magnetic field has no 2d symmetry. Island chains or stochastic regions are formed in the vicinity of magnetic surfaces with rational rotational transform iota = n/m. It is shown that the island with w decays exponentially with m. Results suggest that the anomalous electron transport observed in experiments may be due to the presence of an ambipolar electrostatic potential phi. This hypothesis is proven by computing the guiding center orbits of the electrons and estimating island widths of the drift surfaces that are swept out. It is shown that with a small electric potential depending on the toroidal and poloidal angles, the drift surface island width w is an order of magnitude

larger than that of the magnetic surfaces and decays exponentially at a slower rate.

40142 **(DOE/ET/51013—216) Heating and stabilization by slow waves in the Tara tandem mirror.** Golovato, S.N.; Brau, K.; Casey, J.; Coleman, J.; Gerver, M.; Guss, W.; Hallock, G.; Horne, S.; Irby, J.; Kesner, J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center; Nagoya Univ. (Japan). Inst. of Plasma Physics; Kyoto Univ. (Japan). Dept. of Electronics). May 1987. Contract AC02-78ET51013. 11p. (PFC/CP—87-4; CONF-870570—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011031.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The Tara tandem mirror is typically run in an effectively axisymmetric configuration by not producing β in the quadrupole anchor cells. Slow ion cyclotron wave excitation by a slot antenna located on a midplane bump in the magnetic field of the central cell provides plasma production and heating. Ion cyclotron resonances are at the minimum central cell fields on either side of the bump. Magnetic probe measurements have identified the slow wave excited by the antenna. Effective ion and electron heating is observed with a peak β of over 2%. The ICRF also provides stabilization of an $m = 1$ flute mode which is otherwise unstable in axisymmetric mirror geometry. In conjunction with a magnetic divertor at the central cell midplane, the slow wave can stabilize not only the central cell plasma but additional plasma in the axisymmetric plug cells. Destabilizing β can be produced in the plug cells by neutral beam injection, ICRF, or ECRH. By maintaining the stability of the plugs and central cell, end plugging using either ICRF or ECRH in the plug cells is obtained.

40143 **(DOE/ET/51013—219) Non-resonant mode-coupling model of ICRF heating.** Francis, G.; Bers, A.; Ram, A.K. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 7p. (PFC/CP—87-7; CONF-870570—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011034.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The theory of non-resonant coupling of a well-defined mode to a quasimode is generalized to include the effects of weak inhomogeneity. The resulting formalism is used to determine an analytic form for the transmission coefficient of the fast wave in ICRF heating; this entails the solution of only a first order differential equation. The analytical results, valid for arbitrary k/sub parallel/, are compared with numerical results of usual models involving higher-order differential equations, and found to be in excellent agreement.

40144 **(DOE/ET/51013—220) Electron heating by mode-converted ion-Bernstein waves in ICRF heating of tokamak plasmas.** Ram, A.K.; Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 6p. (PFC/CP—87-8; CONF-870570—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011035.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

In a tokamak plasma, ion-Bernstein waves (IBW) can be excited by mode-conversion of the externally launched fast wave for ICRF heating. This conversion process is known to be efficient for low k/sub parallel/'s which carry substantial power from a single loop antenna. A detailed numerical analysis of the propagation of the IBW shows that the initial small k/sub parallel/ are significantly enhanced along the rays due to toroidal effects. The upshift can occur for short radial distances of propagation and is large enough so that the IBW can Landau damp onto the electrons. This could help explain the observed strong electron heating by ICRF waves in tokamak plasmas. The numerical ray trajectory analysis is done in toroidal geometry for a hot Maxwellian plasma with gradients in temperature, density, toroidal and poloidal magnetic fields included in a WKB sense. A simple analytical model is derived which explains the upshift in k/sub parallel/ and gives results very close to the numerically obtained values. Approximate analytical conditions for appreciable electron Landau damping of the IBW are also given.

40145 **(DOE/ET/51013—222) Analytic descriptions of ion cyclotron absorption.** Bers, A.; Francis, G.; Fuchs, V.; Lashmore-Davies, C.N.; Ram, A.K. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center; Institut de Recherche d'Hydro-Quebec, Varennes (Canada). Projet Tokamak; UKAEA Culham Lab., Abingdon). May 1987. Contract AC02-78ET51013. 7p. (PFC/CP—87-10; CONF-870629—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011037.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Analysis of energy propagation and absorption in ion-cyclotron heating of tokamak plasmas has relied on numerical solutions of fourth (and sixth) order differential equations for slab models of the plasma (poloidal) cross section. Realistic two-dimensional and fully toroidal geometry analyses would become quite unwieldy. It is shown here that the analysis of the slab model can be simplified considerably. A first-order differential equation is shown to describe the transmission coefficient for the fast wave, and it is solved analytically. A second order differential equation is shown to adequately describe both transmission and reflection. Conditions for ion absorption or mode conversion are derived. Including toroidal effects in propagation, conditions for electron absorption on the mode-converted ion-Bernstein waves are also described analytically.

40146 **(IPP—5/13) Subroutine for the fast estimate of ion cyclotron heating efficiency in tokamak plasmas.** Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1987. 45p. NTIS, PC E07; Available from NTIS as TIB/B87-10164.

We describe a subroutine allowing the rapid simulation of ion cyclotron heating in large tokamak plasmas. It is based on analytic estimates of the wave behaviour near resonances, and on drastic but reasonable simplifications of the real geometry. Given the parameters of the plasma and of the antenna, it evaluates the radiated power spectrum, the single transit and total power absorption for each particle species, and rough power deposition profiles. The results of the simple model have been compared with the predictions of ray tracing over a large range of parameters, covering the most common I.C. heating scenarios. Satisfactory agreement is almost always found; unavoidable discrepancies in details can be explained from the approximations made; they are never large for situations of practical relevance. The subroutine can thus be useful for a rapid, shot to shot analysis of experimental data, or as input for transport simulation codes. Moreover it can give enlightening although qualitative information on total (multitransit) absorption, which is difficult to obtain with more sophisticated approaches such as ray tracing and full wave codes.

40147 **(IPP—III/114) Determining the distribution of suprathermal electrons from their bremsstrahlung.** Bernhardi, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1986. 141p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-08674.

The distribution function of suprathermal electrons generated in a tokamak device is determined as a function of the electron impulse and the point of impact in the plasma, from the bremsstrahlung generated by the electrons. For this purpose, the bremsstrahlung is measured with point, direction, and energy resolution, for the same energy range as that of the suprathermal electrons. The method of evaluation is based on analyses revealing the connection existing between the distribution and the flux profiles of the bremsstrahlung, as determined from the measured data. The method as well as its properties in terms of stability are explained in detail.

40148 **(IPP—III/116) Fusion reaction product diagnostics in ASDEX.** Bosch, H.S. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Jan 1987. 105p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06310.

A diagnostic method was developed to look for the charged fusion products from the D(D,p)T-reactions in the divertor tokamak ASDEX. With a semi-conductor detector it was possible to evaluate the ion temperature in thermal plasmas from the proton energy spectra as well as from the triton spectra. In lower-hybrid wave heated plasmas non-thermal (fast) ions were observed. These ions create fusion products with a characteristically different energy spectrum.

40149 **(IPPJ—761) Excitation anisotropy in laser-induced-fluorescence spectroscopy. Broad-line excitation case.** Hirabayashi, A.; Nambu, Y.; Fujimoto, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702498.

Treatment of excitation anisotropy for Laser-Induced-Fluorescence Spectroscopy (LIFS) is extended to the intense excitation case. The depolarization coefficient is derived for intense excitation limit (linearly-polarized or unpolarized light excitation), and the result is presented in tables. For the region of intermediate intensity between the weak and intense excitation limits, the master equation is solved for specific example of transitions and its result is compared with experiment.

40150 **(IPPJ—763) Behaviour of the peripheral plasma in the reversed field pinch.** Matsuoka, A.; Sato, K.I.; Arimoto, H.; Yamada, S.; Nagata, A.; Murata, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702499.

By using Langmuir probes installed behind limiters, time behaviour of the peripheral plasma in the Reversed Field Pinch (RFP) are investigated. They are strongly affected by the confined RFP plasma and are divided into three phases (the initial phase before setting up the RFP configuration, the current rising phase, and the quiescent phase), which are just the same as those of the confined RFP plasma. Typical behaviour of the peripheral plasma have relations to the pump out phenomena and of the toroidal flux generation.

40151 **(IPPJ—765) Transport theory of axisymmetric toroidal plasma with RF wave source in the Pfirsch-Schrueter regime.** Taguchi, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702500.

The neoclassical transport theory of a plasma with the RF wave source is formulated in the Pfirsch-Schrueter regime. The particle and heat fluxes across the magnetic surfaces induced by the RF wave injection are numerically calculated for two ion species plasma. The analytic expressions for these fluxes are also obtained when the parallel phase velocity of the wave is about 2 — 3 times as fast as the ion thermal velocity. When the parallel phase velocity is slower than the ion thermal velocity, the RF wave source is shown to be approximately considered as the momentum, the energy and the heat flow sources.

40152 **(IPPJ—767) Solitary wave of a relativistic magnetosonic wave propagating perpendicularly to a magnetic field.** Ohsawa, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702501.

A relativistic theory for a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field is developed. On the basis of a relativistic two-fluid cold plasma model, structure of a stationary magnetosonic wave is studied. Relativistic effects become important for the parameter regime ω/sub ce//ω/sub pe/ > approx 1, because the fluid electron velocity perpendicular to a magnetic field and parallel to the wave front takes values close to the speed of light for such plasma parameters. It is found that there exists a stationary solitary wave solution even in the relativistic model. Some properties of the solitary wave, such as the soliton width, are discussed.

40153 **(IPPJ—779) Proceedings on US-Japan Workshop A-56 'irradiation effects on plasma diagnostic equipment'.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1986. 70p. (CONF-8601121—Absts.). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702503.

From US/Japan workshop A-56 irradiation effects on plasma diagnostic equipment; Nagoya, Japan (28 Jan 1986).

This is a collection of abstracts and papers for the US-Japan Workshop A-56 on "irradiation effects on plasma diagnostic equipments" held at the Institute of Plasma Physics, Nagoya University, on January 28 through 30, 1986. The topics presented at the workshop are classified as follows: 1) Definition of the problems and general views. 2) Radiation levels estimated from recent experiments and analysis on large tokamaks. 3) Radiation sensitivities of diagnostic components. 4) Neutron sources for irradiation testing. 5) Discussion on suggested experiments on radiation hardening and conclusions. The conclusions summarized by Dr. K.M. Young are also included.

40154 **(IPPJ-DT—123) Control of mixing ratio of two species of fuel gases in the JIPP T-2U Tokamak.** Hirokura, S.; Taniguchi, Y.; Tanahashi, S.; Toi, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1986. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702504.

The gas-feed system controlling the mixing ratio and total pressure of two species of fuel gases has been constructed and tested in the JIPP T-IIU tokamak. The each of two species of pure gases is independently fed through piezo-electric valves respectively. The voltages applied to those valves are feedback-controlled by the each mass signals of which are measured by a quadrupole type of mass spectrometer. This system is successfully used during ICRF heating experiments.

40155 **(IPPJ-DT—125) Plasma focus - dense Z pinch and their applications.** Ishii, Shozo (ed.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1986. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702505.

Workshop on the possibility of Z-pinch as a intense pulse light source in 1983 and Research meeting on plasma focus and Z-pinch in 1984 were held at Institute of Plasma Physics, Nagoya University under a collaborating research program. Research activities reported at the meetings on plasma focus, dense Z-pinch, and related phenomena are summarized.

40156 **(IPPJ-DT—127) Calibration technique for radiation measurements in vacuum ultraviolet - soft x-ray region.** Mizui, Jun-ichi (ed.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1986. 89p. (In Japanese). (CONF-8512124—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702506.

From Workshop on colibration technique for radiation measurements in vacuum ultraviolet - soft X-ray region; Nagoya, Japan (19 Dec 1985).

This is a collection of the papers presented at the workshop on "Calibration Technique for Radiation Measurements in Vacuum Ultraviolet - Soft X-ray Region" held at the Institute of Plasma Physics, Nagoya University, on December 19-20, 1985, under the Collaborating Research Program at the Institute. The following topics were discussed at the workshop: the needs for the calibration of plasma diagnostic devices, present status of the calibration technique, use of the Synchrotron Orbit Radiations for radiometry, and others.

40157 **(IPPJ-DT—128) Emissions from heavy current carrying high density plasma and their diagnostics.** Hirano, Katsumi; Ishii, Shozo (eds.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1986. 95p. (In Japanese). (CONF-8512125—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702507.

From Workshop on emissions from heavy current carrying high density plasma and their diagnostics; Nagoya, Japan (2 Dec 1985).

Workshop on "Emissions from heavy current carrying high density plasma and diagnostics" was held at Institute of Plasma Physics, Nagoya University on 2, and 3, December 1985 under a collaborating research Program. The workshop was attended by 35 researchers from 22 labolatories. A total of 20 papers were submitted and are presented in these proceedings. The largest group of papers was that on soft X-ray emission. It seems this topic is a fore-

most interest for groups which engaged in research of the Z pinch and the plasma focus. A variety of problems in pinched dense plasmas, namely spectroscopy, diagnostics, pinch dynamics, and related engineering aspects were also discussed. The editors of these proceedings wish to thank all authors of papers, workshop participants and the Scientific Committee of the Institute of Plasma Physics, Nagoya University who contributed to the success of this workshop.

40158 **(JAERI-M—86-115) Numerical study of the electron heating and current drive by the fast waves in the JFT-2M tokamak plasma.** Yamamoto, Takumi; Uesugi, Yoshihiko; Hoshino, Katsumichi; Kawashima, Hisato; Ohtsuka, Hideo. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702517.

A 200 MHz fast wave experiment for the JET-2M tokamak is examined. Noticeable single-path electron Landau damping of the fast waves with the parallel refractive index of N/sub parallel/ = 4 is expected in the plasma with electron temperature more than 2.5 keV at the electron density of n/sub e/ = 1.5 x 10^{19} m^{-3}. Furthermore, it is shown that 8 kA of the plasma current is driven by the fast waves with N/sub parallel/≃/2 at n/sub e/ = 3 x 10^{19} m^{-3} in the single-path damping when 100 kW of the rf power radiates into the plasma in the presence of the hot electrons with the temperature of 19 keV and the fraction of the density of 2 %.

40159 **(JAERI-M—86-128) Scaling of incremental energy confinement time of L-mode plasma and comments on improved confinement in tokamaks.** Shimomura, Yasuo; Odajima, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702526.

Incremental energy confinement time defined by tau/sub E//sup ad/ = ΔW/sub p//ΔP/sub t/ is reviewed for L-mode plasmas in various tokamaks with various heating methods where ΔW/sub p/ is incremental plasma energy with increase of heating power ΔP/sub t/. It is shown that tau/sub E//sup ad/ — 0.12a/sub p/^{2} s and tau/sub E//sup ad/ is almost independent of other plasma parameters, heating power and heating methods where a/sub p/ is a plasma minor radius in m and a/sub p/ = 0.1 - 1.15 m. In an optimum H-mode plasma, the incremental energy confinement time is improved by a factor of 4 but the scaling is not clear because of lack of data.

40160 **(JAERI-M—86-160) Two-dimensional Fokker-Planck analysis code for RF current drive.** Okazaki, Takashi; Sugihara, Masayoshi; Fujisawa, Noboru. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702531.

A two-dimensional Fokker-Planck analysis code has been developed to study applicabilities of current drive to fusion reactors by waves in the ion cyclotron range of frequency. The current drive efficiency can be obtained by the code for various kinds of current drive mechnisms, i.e., Landau damping, transit time magnetic pumping, and their combination. The current profile can also be obtained by coupling the code with a wave equation analysis code.

40161 **(Juel—2097) Development and optimization of spherical ionization chambers for ion temperature determination in fission plasmas.** Hoenen, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Technische Hochschule Aachen (Germany, F.R.)). Nov 1986. 86p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-06469.

The development of spherical Pulse Ionisation Chambers for neutron spectroscopy on DD-fusion plasmas is presented. The chambers are filled with Methane plus a small amount of /sup 3/He. Two chambers with different aspect ratios α, (i.e. the ratio of outer to inner electrode radii) have been investigated. The energy resolution for the 765 keV peak from the /sup 3/He(n/sub th/,p)T reaction without correction of electronic noise is 3.27% and 3.07% for aspect ratios of 30 and 40, respectively. These results are confirmed using quasi monoenergetic neutrons generated by a proton beam impinging on a thin solid Ti-T target. Hence, from a practical point of view, ion temperatures ≧ 1 keV can be determined if the statistics of the data are not too poor. Instead of unfolding the proton recoil spectrum, which requires good statistics, the response function is deduced from a normal neutron distribution together with the physical dimensions of the counter and fitted to the high energy flank of the spectrum. A detailed investigation of the time behaviour of this chamber type is performed because the charge collection time and the resultant pulse shaping time for optimum counter resolution are strongly correlated with each other. The experiments performed with the Van de Graaff accelerator clearly indicate that massive shielding and collimation of the detector will be essential for the performance of high resolution measurement. Preliminary results from the experiment JET are presented and compared with results of other methods of ion temperature measurements.

40162 **(UCLA/PPG—1100) The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.** (California Univ., Los Angeles (USA)). Jan 1987. Contract FG03-86ER52126;AC03-84ER53158;FG02-85ER52118;W-7405-ENG-36;AC05-84OR21400;W-31109-ENG-38. 496p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE87010508.

The TITAN research program is a multi-institutional effort to determine the potential of the Reversed-Field Pinch (RFP) magnetic fusion concept as a compact, high-power-density, and "attractive" fusion energy system from economic (cost of electricity, COE), environmental, and operational viewpoints. In particular, a high neutron wall loading design (18 MW/m^2) has been chosen as the reference case in order to quantify the issue of engineering practicality, to determine the physics requirements and plasma operating mode, to assess significant benefits of compact systems, and to illuminate the main drawbacks. The program has been divided into two phases, each roughly one year in length: the Scoping Phase and the Design Phase. During the scoping phase, the TITAN design team has defined the parameter space for a high mass power density (MPD) RFP reactor, and explored a variety of approaches to the design of major subsystems. Two major design approaches consistent with high MPD and low COE, the lithium-vanadium blanket design and aqueous loop-in-pool design, have been selected for more detailed engineering evaluation in the design phase. The program has retained a balance in its approach to investigating high MPD systems. On the one hand, parametric investigations of both subsystems and overall system performance are carried out. On the other hand, more detailed analysis and engineering design and integration are performed, appropriate to determining the technical feasibility of the high MPD approach to RFP fusion reactors. This report describes the work of the scoping phase activities of the TITAN program. A synopsis of the principal technical findings and a brief description of the TITAN multiple-design approach is given. The individual chapters on Plasma Physics and Engineering, Parameter Systems Studies, Divertor, Reactor Engineering, and Fusion Power Core Engineering have been cataloged separately.

40163 (UCLA/PPG—1100, pp 4.1-4.135) **Plasma physics and engineering.** Najmabadi, F.; Bathki, C.G.; Chu, Y.Y.; Conn, R.W.; Cooke, P.I.H.; Kessel, C.E.; Krakowski, R.A.; Miller, R.L.; Nebel, R.A.; Werley, K.A. (Univ. of California, Los Angeles; Los Alamos National Laboratory, NM). Jan 1987. NTIS, PC A21/MF A01. File Number DE87010508.

In The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.

The objectives of the fusion-core physics effort is to identify and study fusion-core plasma physics parameters of the TITAN Reversed-Field Pinch (RFP) reactor, to develop operational scenarios (e.g., start-up, burn), to analyze the fusion-core plasma behavior and performance (e.g., equilibrium and stability, transport), and to study key plasma support subsystems (e.g., current drive, fueling, impurity control and particle exhaust system). As a whole, the fusion-core physics activity provides a detailed description of the fusion core for all engineering activities and design efforts. Feedback is also provided to the system analysis activity to improve parametric system models which are then used to generate new, cost-optimized "strawman" designs for further conceptual engineering design.

40164 **(UCRL—96416) Localized electron-cyclotron heating and current drive in the TIBER-II reactor study.** Smith, G.R.; Logan, B.G.; Kritz, A.H. (Lawrence Livermore National Lab., CA (USA); Hunter Coll., New York (USA)). 1 May 1987. Contract W-7405-ENG-48. 5p. (CONF-870570—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009852.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A scenario is shown for launching 10 MW of 450 GHz extraordinary-mode electron-cyclotron waves into a TIBER-II equilibrium. Localized, high-efficiency current drive near but outside the q = 2 surface causes substantial reduction in the current gradients that may play a role in major disruptions and anomalous transport. The same launch geometry shows promise for heating the plasma core during startup.

40165 **High-resolution duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics.** Schwob, J.L.; Wouters, A.W.; Suckewer, S.; Finkenthal, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 9, 1601-1615(Sep 1987).

A high-resolution, time-resolving soft x-ray multichannel spectrometer (SOXMOS) that permits the simultaneous measurement of emission in two different spectral ranges has been developed and tested extensively for tokamak plasma diagnostics. The basic instrument is a high-resolution, interferometrically adjusted, extreme grazing incidence Schwob—Fraenkel duochromator. The instrument is equipped with two multichannel detectors that are adjusted interferometrically and scan along the Rowland circle. Each consists of an MgF_2 coated, funneled microchannel plate, associated with a phosphor screen image intensifier that is coupled to a 1024-element photodiode array by a flexible fiber-optic conduit. The total wavelength coverage of the instrument is 5—340 A with a measured resolution (FWHM) of about 0.2 A when equipped with a 600-g/mm grating, and 5—85 A with a resolution of about 0.06 A using a 2400-g/mm grating. The simultaneous spectral coverage of each detector varies from 15 A at the short wavelength limit to 70 A at the long wavelength limit with the lower dispersion grating. The minimum readout time for a full spectral portion is 16 ms, but several individual lines can be measured with 1-ms time resolution by selected pixel readout. Higher time resolution can be achieved by replacing one multichannel detector with a single channel electron multiplier detector. Examples of data from the PLT and TFTR tokamaks are presented to illustrate the instrument's versatility, high spectral resolution, and high signal-to-noise ratio even in the 10-A region.

40166 **Volume production of Li^- in a small multicusp ion source.** Walther, S.R.; Leung, K.N.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 8, 566-568(24 Aug 1987). Contract AC03-76SF00098.

Negative lithium ions, generated by volume processes, have been extracted from a small magnetically filtered multicusp ion source. Current densities of 1.9 mA/cm^2 have been obtained with a discharge voltage of 40 V and a discharge current of 4 A.

40167 **Generation of poloidally rotating spheromaks by the conical theta pinch.** Kawai, K.; Pietrzyk, Z.A.; Hunter, H.T. (Aerospace and Energetics Research Program and Department of Nuclear Engineering, University of Washington, Seattle, Washington 98195). *Physics of Fluids;* **30**: No. 8, 2561-2568(Aug 1987).

Spatially resolved spectroscopic measurements revealed the existence of poloidal vortex motion in spheromaks produced in a conical theta pinch. The poloidal velocity on the axis was estimated to be 5 cm/μsec. Large Doppler broadening, which previously was inferred as high ion temperature, is attributed to large internal fluid velocity. A possible effect of the vortex motion in a spheromak merging experiment is studied and found to enhance the fusion reaction rate as a finite temperature beam collider.

40168 **Renormalization of the diffusion tensor for high-frequency, electromagnetic modes.** Litwin, C.; Sudan, R.N. (Department of Nuclear Engineering and Engineering Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **30**: No. 8, 2577-2579(Aug 1987).

The resonance broadening theory is used to derive the diffusion tensor for resonant particles in a spectrum of electromagnetic modes propagating parallel to the magnetic field. The magnetic trapping limit for saturation of wave amplitudes is discussed.

40169 **Two-dimensional finite element multigroup diffusion theory for neutral atom transport in plasmas.** Hasan, M.Z.; Conn, R.W. (Mechanical, Aerospace, and Nuclear Engineering, Department, Center for Plasma Physics and Fusion Engineering, University of California, Los Angeles, Los Angeles, California 90024). *Journal of Computational Physics;* **71**: No. 2, 371-390(Aug 1987).

Solution of the energy-dependent diffusion equation in two dimensions is formulated by multigroup approximation of the energy variable and general triangular mesh, finite element discretization of the spatial domain. Finite element formulation is done by Galerkin's method. Based on this formulation, a two-dimensional multigroup finite element diffusion theory code, FENAT, has been developed for the transport of neutral atoms in fusion plasmas. FENAT solves the multigroup diffusion equation in X—Y cartesian and R—Z cylindrical/toroidal geometries. Use of the finite element method allows solution of problems in which the plasma cross section has an arbitrary shape. The accuracy of FENAT has been verified by comparing results to those obtained using the two-dimensional discrete ordinate transport theory code, DOT-4.3. Results of application of FENAT to the transport of limiter-originated neutral atoms in a tokamak fusion machine are presented. copyright 1987 Academic Press, Inc.

40170 **Electromagnetic field algorithm for 2D implicit plasma simulation.** Mason, R.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **71**: No. 2, 429-473(Aug 1987).

A new, robust algorithm is presented for the implicit calculation of the electromagnetic fields used in the full-particle and hybrid modeling of 2D simulation plasmas. The algorithm allows for calculations at time steps Δt well in excess of the plasma period and for mesh scales Δx far exceeding the Debye length: with electron inertial terms retained. The implicit fields suppress the numerical instability associated with plasma waves. Still, the Δt remain constrained by an electron Courant limit. The algorithm is considerably simpler than earlier implicit schemes, and more complete in its treatment of field errors. In its present form the algorithm is limited to plasmas moving and accelerating in a plane across a single component of magnetic field. An extension to include all the field components is suggested, however. In accordance with the implicit moment method, estimated electric and magnetic fields are obtained by solving Maxwell's equations self-consistently for a set of implicit sources, estimated with the aid of an auxiliary set of lower fluid moment equations (for component fluxes and density). The fluid pressure terms are treated explicitly, and the spatial differencing of the auxiliary moments is centered to facilitate the solution of the resultant field equations.

40171 **Effect of variable eigenmode excitation on RF stabilization of a mirror plasma.** Majeski, R.; Browning, J.J.; Meassick, S.; Hershkowitz, N.; Intrator, T.; Ferron, J.R. (University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **59**: No. 2, 206-209(13 Jul 1987).

It is shown that wave eigenmode fields can provide RF stabilization of the interchange instability. The excitation level of an m = +1 fast magnetosonic wave is controlled by tailoring of the k/sub X/ spectrum of an axial ion-cyclotron radio-frequency antenna array in the Phaedrus-B tandem mirror system. When the k/sub X/ spectrum is chosen to excite the wave strongly, density-fluctuation levels in the plasma are greatly reduced.

40172 **Dynamics of high-Z plasmas produced by a short-wavelength laser.** Goldstone, P.D.; Goldman, S.R.; Mead, W.C.; Cobble, J.A.; Stradling, G.; Day, R.H.; Hauer, A.; Richardson, M.C.; Marjoribanks, R.S.; Jaanimagi, P.A.; and others. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 1, 56-59(6 Jul 1987).

The dynamics and energy flow in Au plasmas produced by a 0.35-μm laser have been studied with layered targets with 6- and 24-beam spherical illumination from the Omega laser, to understand the processes leading to sub-keV x-ray emission. A significant enhancement in x-ray conversion at low intensities is observed for the 24-beam irradiations with higher energy, greater uniformity, and larger targets. Results are interpreted by comparison with hydrodynamics code calculations. The depth of energy penetration and x-ray emission in the plasma appears to be well understood, but some details of the x-ray time signatures and spectra are not.

40173 **Observation of a high-density ion mode in tokamak microturbulence.** Brower, D.L.; Peebles, W.A.; Kim, S.K.; Luhmann N.C. Jr.; Tang, W.M.; Phillips, P.E. (Institute of Plasma and Fusion Research, University of California, Los Angeles, California 90024). *Physical Review Letters;* **59**: No. 1, 48-51(6 Jul 1987).

For high-density Ohmic discharges in the TEXT (Texas Experimental) tokamak, a distinct ion mode (i.e., density fluctuations propagating in the ion diamagnetic drift direction) is observed in the microturbulence spectra. The magnitude and spectral characteristics of this mode are identified. Onset of the ion feature occurs at plasma densities where a clear saturation is evident in the global energy-confinement time tau/sub E/. A possible connection between this experimentally observed ion mode and the theoretically predicted properties of instabilities driven by ion temperature gradient (eta/sub i/) is explored.

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REFER ALSO TO CITATION(S) 38861, 39367, 39390, 39448, 39881, 40162, 40163, 40163, 40163

40174 **(CONF-870629—8-Abst.) Edge dynamics in pellet-fuelled inner-wall jet discharges.** Cohen, S.A.; Ehrenberg, J.; Bartlett, D.V.; Campbell, D.J.; Cheetham, A.D.; de Kock, L.; Gondhalekar, A.; Gottardi, N.; Granetz, R.; Houlberg, W. (JET Joint Undertaking, Abingdon (UK); Princeton Univ., NJ (USA). Plasma Physics Lab.; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010886.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This paper reports on the density behavior in JET during pellet-fuelled inner-wall discharges without auxiliary heating. Certain discharges, characterized by minor disruptions at the q = 2 surface, show a ten times more rapid decay of the plasma density than previously observed. It is shown that this is related to the combined effects of plasma and wall properties.

40175 **(CONF-8705125—1-Vugraphs) Ovecoming matrix organization problems in R & D.** Morgan, O.B. (Oak Ridge National Lab., TN (USA)). 13 May 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02. File Number DE87009677.

From I.R.I. advanced study group 7B: overcoming roadblocks to R and D goals; Chicago, IL, USA (13 May 1987).

This paper describes ORNL's management of its fusion energy program. Guidelines for effective management are given. (JDH)

40176 **(DOE/DP/40152—17) Inertial fusion research: Annual technical report, 1985.** Larsen, J.T.; Terry, N.C. (eds.). (KMS Fusion, Inc., Ann Arbor, MI (USA)). Mar 1986. Contract AC08-82DP40152. 126p. (KMSF-U—1728). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010564.

This report describes the inertial confinement fusion (ICF) research activities undertaken at KMS Fusion (KMSF) during 1985. It is organized into three main technical sections; the first covers fusion experiments and theoretical physics, the second is devoted to progress in materials development and target fabrication, and the third describes laser technology research. These three individual sections have been cataloged separately.

40177 (DOE/DP/40152—17, pp 11-67) **Fusion and plasmas.** Johnson, R.R. (ed.). Mar 1986. NTIS, PC A07/MF A01. File Number DE87010564.

In Inertial fusion research: Annual technical report, 1985.

These experiments were designed to investigate the exploding laser target as well as individual phenomena associated with laser/target interaction. Experiments using cryogenic fuels and fabricated polymer fuel containers are described. Several experiments were performed to characterize plasma conditions relevant to inertial confinement. These experiments involved plasma generated by laser light absorption by thin foil targets, and the determination plasma density profiles for thin foil targets from one and two sides. Theoretical studies are discussed in consideration of two-dimensional effects in parametric instability theories and in analysis of the nonlinear ion-acoustic wave equation. An atomic physics model for use in inertial confinement and x-ray laser simulation has been developed along with a viewfactor code to be used in target experiments of complicated geometry.

40178 (DOE/DP/40152—17, pp 71-105) **Target fabrication technology.** Downs, R.L. (ed.). Mar 1986. NTIS, PC A07/MF A01. File Number DE87010564.

In Inertial fusion research: Annual technical report, 1985.

A crucial part of Inertial Confinement Fusion (ICF) research is the development of new target fabrication technology to meet the program's changing requirements. During this report period, new fabrication methods for both polymer and glass shells were investigated. Cryogenic technology was also utilized in theoretical studies of beta heating for the production of uniform solid fuel layers in very large shells. The permeability of polymer shells and the effects of radiation on this permeability are discussed. The techniques and materials used in fabrication of glass shells are described.

40179 **(DOE/ER/53227—107) Plasma physics research on Tokapole II: Technical progress report for the period November 1, 1985-May 31, 1987.** (Wisconsin Univ., Madison (USA). Plasma Physics Research). 1987. Contract FG02-86ER53227. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011798.

This progress report covers research performed on the Tokapole II tokamak during FY 1986 and FY 1987 (May 1987). Experiments in the following areas are being investigated: turbulence studies, stability property studies of q/sub a/ < 1, disruption studies at 1 < q/sub a/ < 3, Alfven wave loading and resonance studies, gun refueling, and plasma recycling in a scoop limiter. Progress has been accomplished in upgrading of the machine and data acquisition system, along with modification of the divertor ring supports. (LSP)

40180 **(DOE/ET/51013—217) Conceptual requirements for large fusion experiment control, data, robotics, and management systems.** Gaudreau, M.P.J.; Sullivan, J.D. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 7p. (PFC/CP—87-5; CONF-870552—16). NTIS, PC A02. File Number DE87011032.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

The conceptual system requirements for the control, data, robotics, and project management (CDRM) system for the next generation of fusion experiments are developed by drawing on the success of the Tara control and data system. The requirements are described in terms of an integrated but separable matrix of well-defined interfaces among the various systems and subsystems. The study stresses modularity, performance, cost effectiveness, and exportability.

40181 **(EIR—619) Status report: Los Alamos-EIR co-operative work in the field of Nucleonics and Particle Transport in Fusion Reactors for the period July 1, 1984-June 30, 1986.** Dudziak, D.J.; Stepanek, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 21 Mar 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702446.

This is the second Status Report under a co-operation agreement between Los Alamos National Laboratory and EIR in the field of Nucleonics and Particle Transport in Fusion Reactors, covering the period 1 July 1984 to 30 June 1986. Reported is research and development progress in several areas, including deterministic transport methods (TRISM code), stochastic transport methods (MCNP code), and cross-section processing technology (NJOY and TRANSX-CTR codes). Also, capabilities for the analysis of the lithium breeding module (LBM) experiments at the LOTUS facility are discussed. Most effort during this reporting period was devoted to the development of a compatible production version of TRISM at both institutes (including a code users' workshop), to analysis of LBM experiments, to the development of an unresolved resonance treatment in MCNP, to the development of new modules for NJOY, and to the generation of new neutron and photon cross-section libraries.

40182 **(GA-A—18173) Design and analysis of the DIII-D vacuum vessel.** Gallix, R.; Baxi, C.B.; Hoffmann, E.H.; Lightner, S.; Miller, J.E. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1985. Contract AC03-84ER51044. 9p. (CONF-851102—118). NTIS, PC A02. File Number DE87010910.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

A key component in the recent modification by GA Technologies (GA) of its Doublet III tokamak to its current DIII-D configuration is the new dee-shaped vacuum vessel. Inside dimensions of the minor cross section are 2.85 m height, 2.43 m outer radius, and 1.47 m width, giving a 37 m^3 interior volume. The vessel is a single Inconel 625 weldment with 25 to 38 mm thick walls, mostly of sandwich construction with corrugated core. Four 76 mm diameter radial pins support and center the 9 metric ton vessel at mid-height. The vessel has 195 welded-on ports which provide access for pumping, plasma heating, diagnostics, limiter actuators, and maintenance. The ports are single-walled weldments of about 45 different sizes and shapes. They have a total of 215 bolted flanges with diameters up to 673 mm, using either Conflat or Helicoflex metallic seals. The vessel is thermally insulated and capable of being baked out at 400°C by 60 Hz induction heating combined with circulating 1 kg/s of hot air through the vessel wall corrugations and through brazed tubes and welded channels on the outside of the ports. During plasma operation, the average heat flux to the vessel walls is 25 W/cm^2 and cooling is achieved by running water through the air passages. The structural analysis evaluates the effects of mechanical loads (e.g., dead weight, seismic loads, vacuum, air and water pressure); magnetic loads induced by coil faults and 5 MA plasma disruptions; and thermal loads due to bakeout and plasma shots. The resulting stresses are combined and checked against allowables based on ASME B and PV code criteria.

40183 **(GA-A—18795) The status of electron cyclotron heating and current drive and the role of DIII-D.** Prater, R.; Chan, V.S.; Simonen, T.C. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC03-84ER51044. 30p. (CONF-8705140—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009860.

From Department of Energy workshop on electron cyclotron heating; Germantown, MD, USA (4 May 1987).

This report is intended to very briefly assess the status of research into electron cyclotron heating (ECH) and current drive, and to summarize the need for ECH in the compact ignition tokamak (CIT) and engineering tokamak reactor (ETR) devices. It is clear that ECH and current drive experiments need to be performed in the power range between that of present experiments and the power level required for next generation devices. In addition, the DIII-D program of confinement improvement in high beta plasmas can be furthered by the availability of an ECH source compatible in power level with the neutral beam injectors. This report concludes with a discussion of what could be accomplished on DIII-D with a 6 MW ECH source at 120 GHz and how this source might be implemented.

40184 **(HEDL-SA—3416) Effects of irradiation on ferritic alloys and implications for fusion reactor applications.** Gelles, D.S. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76FF02170. 17p. (CONF-860421—76). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010720.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

This paper reviews the ADIP irradiation effects data base on ferritic (martensitic) alloys to provide reactor teams with an understanding of how such alloys will behave for fusion reactor first wall applications. Irradiation affects dimensional stability, strength and toughness. Dimensional stability is altered by precipitation and void swelling. Swelling as high as 25% may occur in some ferritic alloys at 500 dpa. Irradiation alters strength both during and following irradiation. Irradiation at low temperatures leads to hardening whereas at higher temperatures and high exposures, precipitate coarsening can result in softening. Toughness can also be adversely affected by irradiation. Failure can occur in ferritic in a brittle manner and irradiation induced hardening causes brittle failure at higher temperatures. Even at high test temperatures, toughness is reduced due to reduced failure initiation stresses. 39 refs.

40185 **(HEDL-SA—3444) The FUBR-1B experiment, irradiation of lithium ceramics to high burnups under large temperature gradients.** Hollenberg, G.W.; Knight, R.C.; Densley, P.J.; Pember, L.A.; Johnson, C.E.; Poeppel, R.B.; Yang, L. (Hanford Engineering Development Lab., Richland, WA (USA); Argonne National Lab., IL (USA); GA Technologies, Inc., San Diego, CA (USA)). 11 Nov 1985. Contract AC06-76FF02170. 18p. (CONF-860421—77). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010725.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Solid breeder materials used for supplying the tritium for fueling fusion power reactors will be required to withstand a variety of severe environmental conditions such as irradiation damage, thermal stresses and chemical reactions while continuing to produce tritium and not interfering with other essential components in the complex blanket region. In the FUBR-1B experiment several solid breeder candidates are being subjected to the most hostile conditions foreseen in a fusion reactor's blanket. Some material, such as Li_2O, Li_2ZrO_3, and Li_4SiO_4, possess high lithium atom densities which are reflected in high tritium breeding ratios. Other material, such as $LiAlO_2$ and Li_2ZrO_3, appear to have exceptional irradiation stability. Verifying the magnitude of these differences will allow national selection between design options.

40186 **(ILE—8503-P) Optimum design of exploding pusher target to produce maximum neutrons.** Kitagawa, Y.; Miyanaga, N.; Kato, Y.; Nakatsuka, M.; Nishiguchi, A.; Yabe, T.; Yamanaka, C. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Mar 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702449.

Exploding pusher target experiments have been conducted with the 1.052-μm GEKKO MII two-beam glass laser system to design an optimum target, which couples to the incident laser light most effectively to produce the maximum neutrons. Since hot electrons preheat the shell entirely in spite of strongly nonuniform irradiation, a simple model can design the optimum target, of which the shell/fuel interface is accelerated to 0.5 to 0.7 times the initial radius within a laser pulse. A 2-dimensional computer simulation supports this target design. The scaling of the neutron yield N with the laser power P is N proportional to P/sup 2.4+-0.4/.

40187 **(INIS-BR—647) Development of a Nd:YLF solid state laser.** Amaral Neto, R. do; Morato, S.P. (European Physical Society, Geneva (Switzerland)). 1986. 1p. (CONF-8609138—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702482.

From 5. europhysical topical conference on lattice defects in ionic materials; Madrid, Spain (8 Sep 1986).

Published in summary form only.

40188 **(INIS-mf—10914) Recent developments in engineering and technology concepts for prospective tokamak fusion reactors.** Ford, G.W.K. (International Atomic Energy Agency, Vienna (Austria)). 1987. 30p. (CONF-870207—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702491.

From 16. plasma physics conference; Lucas Heights, Australia (9 Feb 1987).

The tokamak has become the most developed magnetic fusion system and it appears likely that break-even and possibly ignition will first be demonstrated in existing machines of this type. Yet larger tokamaks could also demonstrate the essential technologies for the production of useful power. World-wide, well over a hundred tritium-breeder/heat-removal blanket concepts have been devised and preliminary engineering design studies undertaken, but the effort deployed on breeding and power recovery systems has been very small compared with that assigned to plasma research and development. The European Communities' NET (Next European Torus) project may offer an opportunity to redress this imbalance. The NET pre-design stage now in progress for some three years has selected many of the best features of plasma and nuclear design from the world's total efforts in these fields, and the NET concept is described in this paper as exemplifying where magnetic fusion power reactor technology stands today. It is concluded that although there are numerous more advanced types of magnetic confinement fusion reactor at early stages of their physics development, the tokamak offers the best opportunity for the early demonstration of fusion power.

40189 **(IPP—1/239) Gas uptake by coated and uncoated graphite exposed to air.** Vernickel, H.; Bohdansky, J.; Kutsch, H.J.; Ottenberger, W.; Roth, J.; Scherzer, R.; Steinberger, F.; Trcka, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1987. 26p. NTIS, PC E07; Available from NTIS as TIB/B87-10162.

When tokamaks are vented, as is inevitable for repair and modification work, graphite components should adsorb as little gas as possible. This reduces the risk of uncontrolled gas desorption in tokamak operation. The purpose of this investigation is to determine whether various types of graphite differ with respect to gas adsorption and whether a low-Z coating with pyrocarbon or silicon carbide might possibly significantly reduce gas uptake. The investigation was concerned with the gas release of samples in the state in which they were delivered by various manufacturers and with the subsequent gas uptake when they were exposed to air after degassing. There were no drastic differences between the graphites investigated. Pyrocarbon coating does not reduce the short-time gas adsorption within 1-2 days, slows down further gas adsorption by a factor of up to 10 in one case, and not at all in another case. The cause of these big differences has not been clarified. Coating with SiC has just a small influence on gas adsorption. Mass spectrometric investigation of the desorbed gas shows appreciable differences in gas composition and desorption temperature with about equal weight loss. The causes of these differences are not known either.

40190 (IPPJ—769, pp 1-6) **Resonant transformation of electrostatic energy in ExB field system.** Tanizuka, N. (Osaka Prefectural Univ., Sakei, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

A theoretical consideration on an effective transformation of electrostatic potential energy is given. A transformator particle is introduced with the transformation in an ExB field system. A device constant of the system is introduced comparing with some empirical, practical examples and an experimental proof of the transformation is given. Finally a nuclear fusion device plan is proposed based on the idea of the consideration.

40191 (IPPJ—769, pp 18-26) **Effect of magnetic filter on volume production type negative ion source.** Ozasa, T.; Ogasawara, M. (Keio Univ., Yokohama, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Density of negative hydrogen ion H^- produced by volume process is calculated in the tandem multicusp chamber with a magnetic filter and compared with the density in the single multicusp chamber without a magnetic filter. Balance equations for the negative hydrogen ion H^- and for the excited hydrogen molecule H_2^* are solved in the stationary state. The calculated results confirm that the tandem chamber with magnetic filter is effective for producing more H^- ions than the single chamber, and the negative ion density can achieve about 10 times larger value than that obtained with no filter.

40192 (IPPJ—769, pp 221-233) **Anode plasma production processes of low temperature type pulsed ion source.** Horioka, K.; Yoneda, H.; Ohbayashi, K.; Ishizaki, K.; Kasuya, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Production processes of anode plasma for low-temperature type ion sources were investigated. In connection with them, surface flashover processes of low temperature dielectric materials were studied. Ion beam production from adsorbed materials and temperature dependence of anode plasma turn-on time were also reported.

40193 (IPPJ—769, pp 7-17) **Kink stability of long ion layers.** Ishida, A. (Niigata Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

By means of the two-fluid theory, the kink stability of a long thin field-reversed ion layer immersed in a dense low-temperature background plasma is studied theoretically. The two-fluid variational quadratic form with the assumption of rigid displacements in the radial direction yields a new kink stability condition that includes the effect of the non-zero real frequency of the modes, which is due to the inertia of the ion layer. Although it was neglected in previous analyses, this effect is essential to explain the numerical results of Harned. As the ratio of the density of the background plasma to that of the ion layer increases, this new kink stability condition reduces to the conventional condition. The physical mechanism of the kink instability is discussed by means of an analogy with the electrostatic two-stream instability. It reveals that the kink instability may be called an electromagnetic two-stream instability in an inhomogeneous magnetic field.

40194 (IPPJ—769, pp 63-70) **Analysis of propagation of an ion beam pulse in z-discharge plasma channel. 2. Two dimensional model.** Kawasaki, R.; Kato, T. (Waseda Univ., Tokyo, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

The propagation of an ion beam pulse in a Z-discharge plasma channel is analysed theoretically using the Vlasov equation with Fokker-Planck collision terms. For Brevity, the form of the ion beam pulse is assumed to be invariant during the propagation and the plasma channel is also assumed to be in magnetohydrodynamic equilibrium. The equations which describe the space time behavior of the ion beam pulse are derived. The betatron oscillation may excite other mode and yield a new type instability.

40195 (IPPJ—769, pp 40-56) **Analysis for propagation of rotating ion beam.** Kaneda, T.; Niu, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Propagation of LIB(Light Ion Beam) have been studied by using hydrodynamically approximated MHD (magnetohydrodynamics) equations and Vlasov equations based on kinetic thory, so far. In this paper, on the basis of beam, ion and electron's MHD equations of motion of three components, and take account of the electron's drift velocity (using guiding center approximation) and Larmor motion, finite Larmor radius effect is analyzed. And diamagnetic current effect is analyzed here in steady state. The finite Larmor radius effect highly depend on electron temperature. That is, if electrons are in the magnetic field, thermal motion of electrons become to Larmor motion and in other words, the guiding center have a magnetic moment.

40196 (IPPJ—769, pp 57-62) **Propagation of light ion beam.** Okada, T. (Tokyo Univ. of Agriculture and Technology, Koganei, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Electrostatic two-stream and electromagnetic filamentation instabilities for a light ion beam penetrating a plasma are investigated. Stability conditions are derived for propagation through a plasma. The two-stream instability is suppressed by the electron-ion collisions. Stability conditions of filamentation instability are obtained by using a cut off wave number and by including the effect of magnetic field.

40197 (IPPJ—769, pp 27-39) **PIC code for extracting light-ion beam from diode.** Nagamatsu, T.; Niu, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

The beam generation part on Light-Ion-Beam Inertial-Confinement-Fusion (LIB-ICF) program is investigated by the 2 - 1/2 dimensional particle-in-cell code. Some numerical simulation results are presented in this article.

40198 (IPPJ—769, pp 71-79) **New calculation method for target implosion including shock wave.** Tamba, M.; Niu, K. (Institute of Physical and Chemical Research, Wako, Saitama, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

The sound speed in the fuel is derived by using the Sesame Library. It is shown that accelerations by shock waves are inevitable for the fuel implosion, since the final implosion velosity of the fuel is larger than the sound velocity. In order to simulate the implosion motion of the fuel, one-dimensional hydrodynamic codes with artificial viscosities have been employed so far. The ion temperature and the fusion parameter at the most dense stage of the fuel strongly depend on the mesh width through the artificial viscosity. Instead of the artifisial viscosity which expresses the shock waves in the imploding fuel, a shock adoption method is proposed here to be used, which applies the Rankine-Hugoniot relations for the shock wave in the fuel.

40199 (IPPJ—769, pp 80-104) **X-ray-drive inertial-confinement fusion. A way to a fusion reactor.** Yabe, T. (Osaka Univ., Suita, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

A low intensity ion beam of 10^{13} W/cm^2 at 100 ns is shown to be converted into the radiation reservior of $\sigma T^4 = 10^{14}$ W/cm^2, which can provide a few tens of Mbar ablation pressure. The characteristics of X ray both in low- and high-Z materials are investigated justifying the modeling in atomic process and radiation transport.

40200 (IPPJ—769, pp 105-116) **Applications of moving finite element method for ICF target implosion.** Furuta, J.; Niu, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

In inertial confinement fusion (ICF), it is required that DT fuel should be compressed about several thousand times as much as solid density to achieve the fusion reaction. We need to expect how much DT fuel can be compressed in numerical analysis before experimental reserches. In numerical analysis, it is necessary to express the shock waves correctly because a gain of ICF target implosion is much due to the dissipation at the shock fronts. The width of the shock waves is usually a few times as large as the length of mean-free-path, and we have to set several million mesh points for the simulation of these shock waves. This is a serious problem because of the computational memories or CPU time. In the moving finite element (MFE) method, both nodal amplitudes and nodal positions move continuously with time in such a way as to satisfy simultaneous ordinary differential equations (ODEs) which minimize partial differential equation (PDE) residuals. In this report, it is proposed to extend the MFE method for various one-dimensional hydrodynamic equations.

40201 (IPPJ—769, pp 124-140) **Numerical analysis for nonuniform implosion of target.** Nakajima, S.; Niu, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

In the implosion process of inertial confinement fusion by LIB, we attempt to simulate instabilities in the nonuniform and unspherical implosion of a target shell. At present, we are developing the spherical two-dimensional hydrodynamic simulation code (HALLEY). The numerical analysis method for this code is Mixed Eulerian-Lagrangian Method (MEL) because it can describe implosion phenomena that the target shape changes with time rapidly. In this paper, we derive difference equations from basic equations along this method, and discuss initial and boundary conditions and physical and numerical problems.

40202 (IPPJ—769, pp 146-156) **Vaporizing liquid-metal wall of ICF reactor.** Tsuruki, M.; Kawata, S.; Niu, K. (Tokyo Institute of Technology, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

When an ICF reactor is designed, the first wall of the reactor chamber has an important aspect. In the paper, the thermal behavior of the liquid metal is investigated for the water fall type reactor, where the liquid metal is used as the first wall. The safty of this type reactor is also discussed.

40203 (IPPJ—769, pp 174-187) **Linear stability of counter-streaming two strong ion beams.** Abe, K. (Tokyo Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

In connection with the possibility of obtaining the plasma with high ion temperature, the thermalization of counter-streaming two ion beams is studied. The linear stability of the counter-streaming two ion beams is examined to obtain the growth rate of electrostatic waves. Nonlinear developments of the linearly amplified wave and the ion distribution are discussed. The decay wave-wave interaction plays an important role to increase the ion temperature.

40204 (IPPJ—769, pp 234-244) **Effect of UV irradiation on anode plasma production.** Kitamura, A.; Mitsuhashi, K.; Yano, S. (Kobe Univ. of Mercantile Marine, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

For the purpose of improving the anode plasma uniformity and the rise time of the ion current, a trial to trigger the anode plasma formation by an irradiation of photons is made. The anode of a race-track-type MID is synchronously irradiated by a UV radiation emitted from a Xe flash lamp. Several materials are tested as the anode base. An appreciable increasse in the ion current is found especially for a sodium anode.

40205 (IPPJ—769, pp 117-123) **Observation of hydrodynamic instability in spherical target implosion with Gekko XII green laser.** Nishimura, H.; Izawa, Y.; Takabe, H. (Osaka Univ., Suita, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Success of inertial confinement fusion depends upon realization of spherically uniform implosion with the lowest level of preheating. The plausible mechanisms which degrade the sphericity of a compressed core are (1) irregularity of laser heating and (2) hydrodynamic instabilities at the pusher-ablater interface in an acceleration phase and at the pusher-fuel interface in a deceleration phase. Thus, it is of great importance to study the physics of hydrodynamic instability in spherical target implosion. Investigation was made on the stability of an ablatively imploded spherical target in the initial stage of acceleration using Gekko XII green laser (10 kJ/1 nsec at 0.53 μm). The faint corrugation fabricated on a target outer-surface grew exponentially with time, which follows the model of the Rayleigh-Taylor (R-T) instability with classical growth rates up to $k\delta$ - 2π where k is the wave number of the surface corrugation and δ is the amplitude of the instability. The radial distribution of the density is derived from the opacity information of x-ray backlighting data. By varrying the initial amplitude and the wavelength of the corrugation, the instability growth is obtained as a function of accelerated distance X. Experimental data are compared with model calculation. It is concluded that the instability is scaled with the classical growth rate up to $k\delta$ - 2π. (Nogami, K.).

40206 (IPPJ—769, pp 198-220) **Self-similar ion beam fusion plasmas.** Fernandez, A.; Barrero, A. (Universidad de Sevilla, Spain). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

A study is carried out on the one-dimensional self-similar motion of an initially cold half-space plasma of energy per nucleon $E(b) = E_0(t/tau)^2 3/$ and current intensity per unit area $I = I_0(t/tau)^1 3/$ ($T \leqq tau$). The solution is found to be governed by two dimesionless numbers containing the basic beam and plasma parameters: $\alpha = 1.18 \times 10^{-53}. [z(b)^5 A(b)^3 n_0^2 I_0 tau^3/A(i)E_0^5]$ and $\beta = 9.5 \times 10^3$ center dot $E_0 A(b)^{-1}[z(b)I_0 tau]^{-1} 2/$, where z(b) is the ion charge number, A(b) and A(i) are the beam and ion mass number, n_0 (cm^{-2}) is the undisturbed plasma density, and E_0 (MeV), I_0 (A cm^{-2}) and tau (nsec) are the maximum beam energy per nucleon, maximum current intensity and pulse duration, respectively. The plasma motion produced by highly energetic light ion beams (10 MeV) impinging on D-T may correspond to the case $\alpha << 1$. For $\alpha >> 1$, it is found that the plasma flow presents an ablation surface which separates an isentropic compression flow, bounded by a shock from the undisturbed plasma, and a beam energy absorption expansion flow; the results for the expansion region being entirely independent of the compression flow. For the regime $\alpha << 1$, which usually corresponds to the case of a heavy ion beam impinging on D-T, a rarefaction wave is found to separate a heating region where the plasma is heated and its convection is negligible, from a very thin expansion flow region. Finally, discusion is made as to how the plasma behaviour changes as α goes from large to small. (Nogami, K.).

40207 (IPPJ—769, pp 245-252) **Experimental approaches to heavy ion fusion.** Obayashi, H.; Fujii-e, Y.; Yamaki, T. (Nagoya Univ., Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

As a feasibility study on heavy-ion-beam induced inertial fusion (HIF) approach, a conceptual plant design called HIBLIC-I has been worked out since 1982. The characteristic features of this design are summarized. In HIBLIC-I, an accelerator complex is adopted as driver system to provide 6 beams of $^{208}Pb^{+1}$ ions at 15 GeV, which will be simultaneously focussed on a single shell, three layered target. The target is designed to give an energy gain of 100, so that the total beam energy of 4 MJ with 160 TW power may release 400 MJ fusion energy. A reactor chamber is cylindrical with double-walled structure made of HT-9. There are three layers of liquid Li flow inside the reactor. The innermost layer forms a Li curtain which is effective to recover the residual cavity pressure. A thick upward flow serves as coolant and tritium breeder. Tritium will be recovered by yttrium gettering system. A driver system is operated at the repetition rate of 10 Hz and supplies beams for 10 reactor chambers. Then the plant yield of fusion power becomes 4000 MWt, corresponding a net electric output of 1.5 GW. Experimental programs related to HIBLIC-I is described and discussed, including those for heavy-ion-beam experiments and proposals for lithium curtain by electron beam to clarify the key phenomena in HIBLIC-I cavity. (Nogami, K.).

40208 (IPPJ—769, pp 141-145) **Simulation for imploding advanced-fuel-pellet irradiated by particle beam. Neutron heating effects.** Nakashima, H.; Shiba, T. (Kyushu Univ., Fukuoka, Japan). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

In a DD pellet such as Takanawa-I, the rhoR (density times radius) of the pellet is expected to be $\geqq$ 40 g/cm^2, while the range of DT 14 MeV neutron is about 6 g/cm^2. Thus, the 14 MeV neutrons, generated by DT reaction with T produced by one of the branches of the DD reaction, will experience many collisions within the pellet and deposit most of their energy in the pellet. Therefore, it is important to take into account the neutron heating effect in the burn-dynamics simulation of the pellet. The purpose of the present paper is to examine the neutron heating effects by using the simulation code MEDUSA-IB. The MEDUSA-IB code treats the neutron heating by the collision probability method. At each time step, the total energy deposition by neutrons with considering two successive collisions is added to the energy balance equation of ion, and a hydrodynamic equation is solved (adiabatic approach). Burn-dynamics calculation is performed using a model. Results presented include those on the time evolution of ion temperature spatial distribution and the tritium breeding ratio. It is concluded that the neutron heating has great effects on the burn dynamics of the pellet, such as fusion yield and tritium breeding ratio. Thus, it is necessary to take into account the effect precisely, for example, by using the time-dependent neutron transport code, TIMEX. (Nogami, K.).

40209 (IPPJ—770) **Experimental characteristics of ion Bernstein wave heating on JIPP T-IIU tokamak.** Ogawa, Y.; Kawahata, K.; Ando, R. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702502.

The directly launched Ion Bernstein Wave (IBW) heating experiments have been carried out on JIPP T-IIU tokamak for two experimental conditions; (a) the 3rd-branch of the IBW between 3rd- and 4th-cyclotron harmonics of the deuterium, and (b) the 2nd-branch of the IBW between 2nd- and 3rd-cyclotron harmonics. In the case (a), the direct hydrogen heating at $\omega = 1.5$ Ω/sub H/ has been found in previous experiments. Here the authors present additional data to support this subharmonics heating, i.e., the spectroscopic measurement of Fe XVIII lines and mass separated analysis of charge-exchange neutrals. While, in the case (b), the remarkable increase of the electron temperature has been observed, espe-

cially at the central region of the plasma, and it has been estimated from the global energy balance that almost all of IBW power is delivered to the electron. To investigate this difference of the heating mode, the power absorption has been calculated with the ray tracing code, taking into account of the effect of the plasma/antenna coupling. It is concluded from the consideration of the electron Landau damping that the transition from the ion heating mode to the electron one would be explained by the difference of the electron temperature at the ohmic phase; i.e., T/sub e/ (0) = 0.7 keV for the case (a) and T/sub e/ (0) = 1.3 keV for the case (b).

40210 **(JAERI-M—86-110) Feedback control of plasma configuration in JT-60.** Ninomiya, Hiromasa; Kikuchi, Mitsuru; Yoshino, Ryuji; Hosogane, Nobuyuki; Kimura, Toyoaki; Kurihara, Kenichi; Takahashi, Minoru; Hayashi, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 60p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702514.

Plasma current, plasma position (center of the outermost magnetic surface), decay index n/sub index/ and width of the divertor throat are feedback controlled by using 5 kinds of poloidal field coils in JT-60. Five control commands are calculated in a feedback control computer in each 1 msec. These feedback control functions are checked in ohmically heated plasma. The control characteristics of the plasma are well understood by the simplified control analysis and are consistent with the precise matrix transfer function analysis in the frequency domain and the simulation analysis which include the effects of eddy currents, delay time elements and mutual interactions between controllers. The usefulness of these analyses is experimentally confirmed. Each controlled variable is well feedback controlled to the command and the experimentally realized equilibrium configuration is checked by the well calibrated magnetic probes. Fast boundary identification code is used for the identification of the equilibrium and results are consistent with the precalculated plasma equilibria. By using this feedback control system of the plasma configuration and the equilibrium identification method, we have obtained the stable limiter and divertor configuration. The maximum parameters obtained during OH(I) experimental period are plasma current I/sub p/ = 1.8 MA, the effective safety factor q/sub eff/ < 3, the plasma density n-bar/sub e/ = 5.7 x 10^{19} m^{-3} (Murakami parameter of 4.5) and the pulse length of 5 — 10 sec.

40211 **(JAERI-M—86-124) PROF-DD: A code system for generation of multi-group double-differential form cross section library.** Mori, Takamasa; Nakagawa, Masayuki; Ishiguro, Yukio. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702523.

The PROF-DD code system has been developed to generate the multi-group double-differential form cross section (DDX) library by processing the nuclear data file compiled with the ENDF/B-IV or -V format. This system consists of five steps : MCFILEF, RESENDD, SPINPTF, PROF-DDX and DDXLIBMK. By using this system, a user can easily produce a multi-group DDX library with a few input data, and make figures of the processed DDX data. The produced DDX library can be used for fusion neutronic calculations by the Monte Carlo code MORSE-DD, 1- and 2-dimensional Sn transport codes ANISN-DD and DOT-DD. This report has been prepared as a user manual of the PROF-DD code system.

40212 **(JAERI-M—86-130) In-pile experiment for tritium recovery from Li_2O (VOM-21H). Tritium chemical form as a function of sweep gas composition.** Takeshita, Hidefumi; Kurasawa, Toshimasa; Matsui, Tomoaki; Watanabe, Hitoshi; Yoshida, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702527.

The VOM-21H irradiation test, an experiment of in-situ tritium recovery from sintered Li_2O pellets, has been carried out at the JRR-2 of JAERI. This report focuses on the relationship between tritium chemical form and hydrogen concentration in the sweep gas. The tritium generation rate in the VOM-21H experiment was about 300 μCi/min. This rate was equivalent to 1 ppm of tritium concentration (as T_2O or T_2) in the sweep gas. Concentrations of deuterium added to the sweep gas were 10, 100 and 1000 ppm. It was found that tritium release enhancement by hydrogen addition to the sweep gas is caused by conversion of tritiated water vapor to tritiated hydrogen gas through the hydrogen isotopic exchange reaction. The relationship between hydrogen concentration and conversion efficiency was consistent with thermodynamic calculation.

40213 **(JAERI-M—86-133) Effects of geometry on FER divertor plasma.** Hitoki, Shigehisa; Sugihara, Masayoshi; Yamamoto, Shin. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702529.

Geometric effects have been investigated on the cold and dense divertor plasma formation. So far, this problem has been discussed only qualitatively. Here the results of numerical calculations are presented quantitatively, with the throat length and the void width as the parameters. Such data will be useful data base for the FER engineering design. It is concluded that the effectively closed divertor will work better than the open divertor. The closed divertor with no void width forms a cold and dense divertor plasma for a wide range of throat length.

40214 **(JAERI-M—86-161) Impurity transport in ohmically heated JT-60 plasma.** Hirayama, Toshio; Sugie, Tatsuo; Sakasai, Akira; Kubo, Hirotaka; Koide, Yoshihiko; Akaoka, Nobuo; Takeuchi, Hiroshi; Nagami, Masayuki. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702532.

In the ohmically heated plasma of JT-60, the transport of impurities has been studied by VUV and soft X-ray crystal spectroscopies, and from bolometer and soft X-ray diode signals, along with one-dimensional impurity transport code. Changing over a discharge from the limiter mode to the divertor mode, the decay of the bolometer signals was measured and the time constant was about 0.3 sec in the central chord. Temporal evolutions of T/sub i/ XIII(23.356A), T/sub i/ XX(259.3A) and T/sub i/ XXI (resonance line) were obtained in two different discharges with I/sub p/ = 2MA which a piece of titanium was accidentally injected into. The comparison of the time behaviour of the respective lines with the simulation results by a diffusive/convective transport model shows that the anomalous diffusion coefficient is about 1.0 m^2/s and convective inward velocity is not seen.

40215 **(Juel—2078) Non-steady temperature distribution and deformation of copper plates with one-sided heat flux used as targets for neutral beam injection.** Bousack, H.; Phlippen, P.W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie; Duisburg Univ. (Gesamthochschule) (Germany, F.R.). Fachgebiet Energietechnik). Jul 1986. 123p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06472.

The present study deals with the heat-engineering design of plate-type targets with one-sided heat flux. The relevant analytic equations are compiled to calculate the non-steady temperature development for the one-dimensional case. A specially developed finite difference program can calculate the exact three-dimensional non-steady temperature field produced by a two-dimensional power density distribution. The plastic properties of the material can be used in determining the stresses and deformations from the temperature field computed. Calculations using a copper target from the neutral beam injector of the TEXTOR pilot facility are carried out as an example and compared with the results obtained from experiments on a scaled-down model. Furthermore, the results from the experimental cooling of hot cooling plates and a simple method of computation are presented.

40216 **(Juel—2086) Plasma induced material defects and threshold values for thermal loads in high temperature resistant alloys and in refractory metals for first wall application in fusion reactors.** Bolt, H.; Hoven, H.; Kny, E.; Koizlik, K.; Linke, J.; Nickel, H.; Wallura, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Metallwerk Plansee A.G., Reutte/Tyrol (Austria)). Oct 1986. 90p. NTIS, PC E09; Available from NTIS as TIB/B87-10163.

Materials for the application in the first wall of fusion reactors of the tokamak type are subjected to pulsed heat fluxes which range from some 0.5 MW m/sup -2/ to 10 MW m/sup -2/ during normal plasma operation, and which can exceed 1000 MW m/sup -2/ during total plasma disruptions. The structural defects and material fatigue caused by this types of plasma wall interaction are investigated and the results are plotted in threshold loading curves. Additionally, the results are, as far as possible, compared with quantitative, theoretical calculations. These procedures allow a semiquantitative evaluation of the applicability of the mentioned metals in the first wall of fusion reactors.

40217 **(Juel—2114) Influence of adsorbed hydrogen molecules on the hydrogen permeation and recycling.** Banno, T. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Duesseldorf Univ. (Germany, F.R.)). Jan 1987. 142p. NTIS, PC E11; Available from NTIS as TIB/B87-10165.

Hydrogen permeation through a thin iron membrane has been measured using a molecular hydrogen gas and/or a weakly ionized rf-discharge as particle sources. Transient and steady state values of the permeation flux phi/sub p/ were obtained in the regime where the surface penetration of H and the recombinative release of H/sub 2/ are rate-determining. phi/sub p/ is then proportional to the flux density psi of the particles which impinge on the membrane upstream. The proportionality factors depend on the nature (atomic or molecular) of the incident particles, on temperature (in particular for a molecular driving gas) and on the ratio of the surface recombinative release rate constants (2σk/sub r/)/sub u/ and (2σk/sub r/)/sub d/ up- and downstream, respectively.

40218 **(KFK—4210) Stress and lifetime calculations for first wall and blanket structural components. Pt. 2. Crack propagation in the NET first wall.** Diegele, E.; Fett, T.; Munz, D.; Stamm, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Mar 1987. 114p. NTIS, PC E11; Available from NTIS as TIB/B87-10152.

In this report lifetime results for first wall components of a fusion reactor are presented. The aim is to show the general procedure for lifetime calculations, to demonstrate the principal mechanical behaviour of plasma faced structures, to consider effects of radiation on the behaviour of the material and assess lifetimes whithin the framework of fatigue crack growth analysis. The treatment of lifetime predictions is outlined in case of a first wall concept proposed by the NET-team for two materials, an austenitic steel (SS316CW) and a martensitic steel (1.4914). In general the results show a superiority of martensitic steel compared with austenitic steel.

40219 **(LBL—22211) Transverse combining of nonrelativistic beams in a multiple beam induction linac.** Celata, C.M.; Faltens, A.; Judd, D.L.; Smith, L.; Tiefenback, M.G. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—153). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009153.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Emittance growth of beams during transverse combining has been studied computationally and experimentally for Heavy Ion Fusion applications, and the theory and results are presented. A hardware design is also discussed.

40220 **(PFC/CP—87-1) Prospects for fusion: The winds of change.** Davidson, R.C. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1987. 18p. (CONF-870457—2). NTIS, PC A02/MF A01. File Number DE87900826.

From Annual meeting of Fusion Power Associates; Pleasanton, CA, USA (8 Apr 1987).

This paper addresses the following topics: (1) national energy circumstances and policy, and the implications for fusion; (2) the intrinsic merit of fusion research and development as it contributes to the national science and technology base; (3) the research opportunities and priorities in inertial confinement fusion; and (4) the research opportunities and priorities in magnetic fusion.

40221 **(SAND—86-2559C) Experimental verification of subcooled flow boiling for tokamak pump limiter designs.** Koski, J.A.; Beattie, A.G.; Whitley, J.B.; Croessmann, C.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 26p. (CONF-870816—11). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006711.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

In fusion energy research devices such as tokamaks, limiters are used to define the plasma boundary, and may serve the additional functions of plasma density and impurity control by removing neutralized particles from the plasma edge region. Because the devices must operate in the plasma edge or "scrape-off-layer," they are subject to high heat fluxes. In this paper, experimental studies for a pump limiter design currently under development are discussed. Subcooled flow boiling of water and twisted tape flow enhancement are combined to enable heat removal of highly peaked local heat fluxes at the tube-water boundary in the 40 to 50 MW/m^2 range. Experiments were conducted with the use of a rastered 30 kV electron beam apparatus which is capable of producing the desired steady state heat flux levels. Objectives of the experiment were (1) to verify the heat removal model used for finite element thermal and stress analyses, (2) selection of appropriate critical heat flux (CHF) margins and criteria, and (3) development of acoustic techniques to monitor the onset of CHF during actual limiter operation.

40222 **(SAND—87-0349C) Small windows on a large system.** Miller, D.P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870841—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007023.

From 2. international conference on human-computer interaction; Honolulu, HI, USA (10 Aug 1987).

The Particle Beam Accelerator (PBFA-II) recently completed at Sandia National Laboratories in the most powerful pulsed-power accelerator in the free world. The facility comprises over 25 major subsystems that are controlled by a small operations crew through a computerized control/monitor system (C/MS), which operates or monitors over 1900 points in the various subsystems. The operators' primary interface with the C/MS is a console containing seven 19-inch color monitors with touch panels and other dedicated hardware. This paper discusses some unique problems associated with this human-computer-system interaction and describes several ergonomic design solutions. Application areas include color graphics displays, menu selection, soft-key coding, command structure, and approaches taken toward manual, semi-automatic, and automatic control modes.

40223 (UCLA/PPG—1100, pp 5.1-5.41) **Parametric systems studies.** Miller, R.L.; Krakowski, R.A. (Los Alamos National Laboratory, NM). Jan 1987. NTIS, PC A21/MF A01. File Number DE87010508.

In The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.

The objective of the Systems Analysis Activity is the systematic study and determination of plant operating parameters through economic analysis and optimization of the power station. The designs are chosen to meet program design goals (e.g., minimal cost of electricity, COE, and high mass power density). Code

models include steady-state surveys designed to assess sensitivities and trade-offs related to various TITAN operating configurations and assumptions, as well as time-dependent start-up/burn simulations (Sec. 4.5.2). These models are bench-marked and calibrated against more detailed plasma physics and magnetic models to provide a framework for the overall design process. [At least as important as the Strawman designs.] This report summarizes the physics, engineering, and costing models used in the PSA code, presents results of the Parametric Systems Analysis (PSA) studies performed to date, and summarizes the parameters of the present set of design points.

40224 (UCLA/PPG—1100, pp 6.1-6.72) **Divertor.** Cooke, P.I.H.; Bathke, C.G.; Conn, R.W.; Dabiri, A.E.; Duggan, W.P.; Fischer, O.; Grotz, S.P.; Hasan, M.Z.; Krakowski, R.A.; Najmabadi, F.; Prinja, A.K.; Sharafat, S.; Vold, E.L.; Werley, K.A. (Univ. of California, Los Angeles; GA Technologies Inc., San Diego, CA; Los Alamos National Laboratory, NM; Rensselaer Polytechnic Institute, Troy, NY; Fusion Engineering Design Center, Oak Ridge, TN). Jan 1987. NTIS, PC A21/MF A01. File Number DE87010508.

In The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.

An efficient mechanism for particle exhaust and impurity control will be an essential component of any magnetic fusion reactor, in order that the products of the fusion reaction can be removed and to avoid excessive contamination of the plasma core. Little work has been performed on impurity control systems for reversed field pinch (RFP) reactors. For the compact reversed field pinch reactor (CRFPR), which represents the only major contribution to the field, a pumped limiter was used for the reference design although options for a divertor were also examined. For the scoping phase of the project the work has concentrated on issues influencing the feasibility of the toroidal divertor concept. The magnet configuration is discussed followed by work on the modeling of the edge-plasma, including estimates of the conditions at the divertor target. The relationship between the first wall and divertor heat loads is described and the various heat removal concepts that have been considered are discussed. Finally, conclusions from the work performed so far are presented, followed by plans for further work during the next phase of the project.

40225 (UCLA/PPG—1100, pp 7.1-7.11) **Reactor engineering.** Thomson, S.L.; Dabiri, A.E.; Lousteau, D.C. (Fusion Engineering Design Center, Oak Ridge, TN). Jan 1987. NTIS, PC A21/MF A01. File Number DE87010508.

In The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.

The primary objective in increasing the power density of the fusion power core (FPC) is the decrease in size, decrease in capital and development costs, and a reduction in repair and down times. As part of this overall approach, a single-piece maintenance approach has been utilized, and a general plant arrangement has been developed that takes advantage of the simplicity of the single-piece maintenance approach. This chapter describes the compact Fusion Power Reactor (FPR) design configuration including coolants and energy conversion systems. A description of the maintenance approach and general plant layout is also provided. (FI)

40226 (UCLA/PPG—1100, pp 8.1-8.134) **Fusion power core engineering.** Grotz, S.P.; Blanchard, J.P.; Cheng, E.T.; Cooke, P.I.H.; Conn, R.W.; Creedon, R.L.; Dabiri, A.E.; Duggan, W.P.; Fischer, O.; Ghoniem, N.M. (Univ. of California, Los Angeles; GA Technologies Inc., San Diego, CA; Los Alamos National Laboratory, NM; Rensselaer Polytechnic Institute, Troy, NY; Fusion Engineering Design Center, Oak Ridge, TN). Jan 1987. NTIS, PC A21/MF A01. File Number DE87010508.

In The TITAN Reversed-Field Pinch fusion reactor study: Scoping phase report.

Several fusion power core (FPC) concepts were proposed and studied during this research phase. Four concepts were selected for further analysis. These concepts are a self-cooled lithium loop design with a vanadium alloy structure; an aqueous, self-cooled design with a copper first wall, beryllium neutron multiplier, and Primary-Candidate-Alloy structure; a self-cooled FLiBe pool design using a vanadium structure; and a helium-cooled ceramic design with a solid breed and silicon carbide structure. This chapter describes these FPC design concepts and investigates the design performance in materials, neutronics, thermal hydraulics, structural analysis, tritium, and safety analysis. (FI)

40227 **(UCRL—93046-Rev.1) Substantial reductions of input energy and peak power requirements in targets for heavy ion fusion.** Mark, J.W.K.; Pan, Y.L. (Lawrence Livermore National Lab., CA (USA)). 6 Oct 1986. Contract W-7405-ENG-48. 7p. (CONF-8610285—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008743.

From Heavy ion fusion symposium; Washington, DC, USA (1 Oct 1986).

Two ways of reducing the requirements of the heavy ion driver for inertial confinement fusion (ICF) target implosion are described. Compared to estimates of target gain not using these methods, the target input energy and peak power may be reduced by about a factor of two with the use of the hybrid-implosion concept. Another factor of two reduction in input energy may be obtained with the use of spin-polarized DT fuel in the ICF target.

40228 **(UCRL—94348-Rev.1) Approaching maximal performance of longitudinal beam compression in induction accelerator drivers.** Mark, J.W.K.; Ho, D.D.M.; Brandon, S.T.; Chang, C.L.; Drobot, A.T.; Faltens, A.; Lee, E.P.; Krafft, G.A. (Lawrence Livermore National Lab., CA (USA); Science Applications International Corp., McLean, VA (USA); Lawrence Berkeley Lab., CA (USA); Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 24 Sep 1986. Contract W-7405-ENG-48. 12p. (CONF-8609289—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009616.

From International symposium on heavy ion fusion; Washington, DC, USA (24 Sep 1986).

Longitudinal beam compression occurs before final focus and fusion chamber beam transport and is a key process determining initial conditions for final focus hardware. Determining the limits for maximal performance of key accelerator components is an essential element of the effort to reduce driver costs. Studies directed towards defining the limits of final beam compression including considerations such as maximal available compression, effects of longitudinal dispersion and beam emittance, combining pulse-shaping with beam compression to reduce the total number of beam manipulators, etc., are given. Several possible techniques are illustrated for utilizing the beam compression process to provide the pulse shapes required by a number of targets. Without such capabilities to shape the pulse, an additional factor of two or so of beam energy would be required by the targets.

40229 **(UCRL—95021) Designing the Cascade inertial confinement fusion reactor.** Pitts, J.H. (Lawrence Livermore National Lab., CA (USA)). 9 Feb 1987. Contract W-7405-ENG-48. 7p. (CONF-870812—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006240.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The primary goal in designing inertial confinement fusion (ICF) reactors is to produce electrical power as inexpensively as possible, with minimum activation and without compromising safety. This paper discusses a method for designing the Cascade rotating ceramic-granule-blanket reactor (Pitts, 1985) and its associated power plant (Pitts and Maya, 1985). Although focus is on the cascade reactor, the design method and issues presented are applicable to most other ICF reactors.

40230 **(UCRL—96002) The Mirror Fusion Test Facility cryogenic system: Performance, management approach, and present equipment status.** Slack, D.S.; Chronis, W.C. (Lawrence Livermore National Lab., CA (USA); Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 8 Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-8706125—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010807.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

The cryogenic system for the Mirror Fusion Test Facility (MFTF) is a 14-kW, 4.35-K helium refrigeration system that proved to be highly successful and cost-effective. All operating objectives were met, while remaining within a few percent of initial cost and schedule plans. The management approach used in MFTF allowed decisions to be made quickly and effectively, and it helped keep costs down. Manpower levels, extent and type of industrial participation, key aspects of subcontractor specifications, and subcontractor interactions are reviewed, as well as highlights of the system tests, operation, and present equipment status. Organizations planning large, high-technology systems may benefit from this experience with the MFTF cryogenic system.

40231 Neutron spectra from inertial confinement fusion targets for measurement of fuel areal density and charged particle stopping powers. Cable, M.D.; Hatchett, S.P. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 6, 2233-2236(15 Sep 1987). Contract W-7405-ENG-48.

Measurements of the ratio of dt to dd neutrons from pure deuterium fuel have been used as a method for determination of fuel areal density (<rhoR>). The relationship between fuel <rhoR> and dt neutron production becomes uncertain for <rhoR> values large enough that the 1.01-MeV tritons from the d(d,t)p reaction lose a significant amount of energy in the fuel. A method based on neutron spectroscopy is described that improves the determination of fuel <rhoR> in the region where tritons lose significant energy but have not yet thermalized. Charged particle stopping powers relevant to inertial confinement fusion ignition conditions may also be determined.

40232 Development of low-energy beams for fueling the central cell of a tandem mirror. Pincosy, P.A.; Turner, W.C. (TRW, Inc., Redondo Beach, California 90278). *Review of Scientific Instruments;* **58**: No. 9, 1576-1588(Sep 1987).

In this article we describe the theoretical motivation and experimental development of low-energy (2 keV) neutral beams for fueling the central cell of the TMX-U thermal-barrier tandem mirror experiment at Lawrence Livermore National Laboratory. Theoretical estimates are given for the beam current required to build up a low-density plasma (n/sub c/ = 0.5—2.5 x 10^{12} cm^{-3}) to a final-state high-density plasma (n/sub c/ = 1 x 10^{13} cm^{-3}). The design of low-divergence (+- 3^{0}) beam modules is described together with test stand measurements of beam-neutral current, divergence, and species fractions. Experimental results are given for injection of 45 aA of low-energy neutral-beam current into the central cell of TMX-U.

40233 Single-mode operation of a high-power, step-tunable gyrotron. Kreischer, K.E.; Temkin, R.J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 5, 547-550(3 Aug 1987).

A gyrotron oscillator with a single cylindrical cavity has produced output powers up to 645 kW and efficiencies up to 24% at 140.8 GHz, and step-tunable single-mode operation between 126 and 243 GHz. Mode stability and suppression of nearby competing modes are found to persist even for operation in very high-order cavity modes with severe mode competition. These results greatly improve prospects of developing cw megawat gyrotrons relevant to the heating of fusion plasmas.

40234 Compatibility of ferrous alloys in a forced circulation Pb-17Li system. Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 566-570(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Corrosion data have been obtained on ferritic HT-9 and Fe-9Cr-1Mo steel and austenitic Type 316 stainless steel in a flowing Pb-17 at.% Li environment at temperatures between 371 and 482°C. The corrosion behavior is evaluated by measurement of weight loss as a function of time and temperature. Metallographic examination of the materials exposed to the flowing Pb-17Li environment is presented.

40235 Corrosion of Fe-Cr-Mn alloys in thermally convective lithium. Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 579-583(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

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A series of austenitic Fe-Cr-Mn steels was exposed to circulating lithium at temperatures up to 500°C. Two groups of the alloys, which contained 12 to 30 wt% Mn and 2 to 20 wt% Cr, were sequentially exposed for periods greater than 3000 h in a type 316 stainless steel thermal convection loop. Mass transfer of manganese caused very large weight losses from the steels containing 30 wt% Mn. However, the actual magnitude of corrosion losses for alloys containing 12 to 20 wt% Mn was difficult to establish due to competing surface reactions involving chromium.

40236 Influence of temperature and lithium purity on corrosion of ferrous alloys in a flowing lithium environment. Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 584-591(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Corrosion data have been obtained on ferritic HT-9 and Fe-9Cr-1Mo steel and austenitic Type 316 stainless steel in a flowing lithium environment at temperatures between 372 and 538°C. The corrosion behavior is evaluated by measurements of weight loss as a function of time and temperature. A metallograhic characterization of materials exposed to a flowing lithium environment is presented.

40237 Corrosion of ferrous alloys exposed to thermally convective Pb-17 at% Li. Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 592-598(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

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A type 316 stainless steel thermal convection loop with type 316 stainless steel coupons and a Fe-9Cr-1Mo steel loop containing Fe-12Cr-1Mo VW steel specimens circulated molten Pb-17 at% Li at a maximum temperature of 500°C. Specimens were exposed for more than 6000 h. Mass loss and surface characterization data were compared for these two alloys. At any particular exposure time, the corrosion of type 316 stainless steel by Pb-17 at% Li was more severe, and of a different type than that of similarly exposed Fe-12Cr-1Mo VW steel. The austenitic alloy suffered nonuniform penetration and dissolution by the lead-lithium, whereas the Fe-12Cr-1MoVW steel tended to be more uniformly corroded. The presence of a ferritic layer on the type 316 stainless steel, and its susceptibility to spalling during specimen cleaning, were shown to be important in evaluating the data for this steel and in comparing corrosion losses for the two types of alloys. A model for the nonuniform penetration of type 316 stainless steel by Pb-17 at% Li was suggested.

40238 Corrosion behavior of vanadium-base alloys in pressurized water at 288°C. Diercks, D.R.; Smith, D.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 617-621(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The aqueous corrosion behavior of two heats each of V-15Cr-5Ti and V-20Ti, and of a single heat of VANSTAR-7, was investigated at 288°C in high-purity pressurized water containing 4, 0.19, and 0.03 wppm dissolved O_2. Total exposure time in each case was 2000 h. The V-15Cr-5Ti alloy was found to exhibit substantially lower corrosion rates than did the other two alloys at all three dissolved O_2 levels. It was the only alloy that appeared to satisfy the maximum corrosion wastage rate criterion of 0.005 to 0.020 mm/yr for fusion reactor first-wall materials. The phases VO_2, TiO_2 (rutile), and possibly Cr/sub 0.10/V/sub 0.90/O_2 and TiV_2O_5 were identified in the corrosion product formed on the V-15Cr-5Ti specimens. TiO_2 was the only phase observed on the V-20Ti specimens, and the corrosion product formed on the VANSTAR-7 specimens could not be identified.

40239 **Control of helium effects in irradiated materials based on theory and experiment.** Mansur, L.K.; Lee, E.H.; Maziasz, P.J.; Rowcliffe, A.P. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 633-646(Nov-Dec 1986). (CONF-860421—).

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Helium produced in materials by (n,α) transmutation reactions during neutron irradiation or during dual-iron irradiation experiments causes substantial changes in the response to displacement damage In particular, swelling, phase transformations and embrittlement are strongly affected. Present understanding of the mechanisms underlying these effects is reviewed. Key theoretical relationships describing helium effects on swelling and helium diffusion are described. Experimental data in the areas of helium effects on swelling and precipitation is reviewed with emphasis on critical experiments that have been designed and evaluated in conjunction with theory. Confirmed principles for alloy design to control irradiation performance are described.

40240 **New ideas in dosimetry and damage calculations for fusion materials irradiations.** Greenwood, L.R. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 654-657(Nov-Dec 1986). (CONF-860421—).

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Nuclear data and techniques are being developed to improve our ability to characterize fusion materials irradiations. The production of long-lived isotopes have been measured near 14 MeV, including reactions from Al, Fe, and Mo to ^{26}Al, ^{53}Mn, and ^{94}Nb, respectively. These data can be used for fusion reactor activation, dosimetry, and plasma diagnostics. Dosimetry cross sections can be adjusted using measurements at Be(d,n) sources (E/sub d/=7-40 MeV) and mono-energetic neutron sources from 1 to 14 MeV. Helium production cross sections are being tested at all fusion irradiation facilities. We have recently discovered a new thermal helium production in copper, similar to the well-known effect in nickel. Recommended cross sections and procedures are included. A new program SPECOMP has been developed to calculate displacement damage for compounds. This program uses the SPECTER recoil atom distributions and integrates over secondary displacement functions for each combination of incident ion and matrix material to determine displacement cross sections for alloys, insulators, and breeder materials.

40241 **Nonequilibrium statistical theory of bubble nucleation and growth under neutron and proton irradiation.** Yu Jinnan; Sommer, W.F.; Bradbury, J.N. (Institute of Atomic Energy, Beijing, China; Los Alamos National Lab., NM). *Journal of Nuclear Materials;* **141-143**: No. B, 658-664(Nov-Dec 1986). (CONF-860421—).

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Microstructural evolution in metals under particle irradiation is described by a nonequilibrium statistics method. This method gives a set of equations for the evolution of bubbles and an approximate solution for a distribution function of bubble size as a function of fluence and temperature. The distribution function gives the number of bubbles of radius r at time t, N(r,t)dr, as a functon of size, r/r_0 (r_0 is the radius of a bubble nucleus). It is found that N(r,t) dr increases with fluence. Also, the peak value of N(r,t)dt shifts to higher r/r_0 with increasing fluence. Nucleation depends mainly on helium concentration and defect cluster concentration while bubble growth is controlled mainly by the vacancy concentration and a fluctuation coefficient. If suitable material parameters are chosen, a reasonable distribution function for bubble size is obtained. The helium diffusion coefficient is found to be less than that for vacancies by five orders of magnitude. The fraction of helium remaining in matrix is less than 10^{-2}; the majority of the helium is associated with the bubbles.

40242 **Evaluation of defect production cross sections and calculated fisson-fusion neutron spectrum sensitivity.** Simons, R.L. (Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. B, 665-671(Nov-Dec 1986). (CONF-860421—). Contract AC06-76FF02170.

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A semi-empirical method is presented of deriving PKA cross sections for production of Frenkel pairs produced by irradiation of pure metals at liquid helium temperatures. Cross sections derived by this method were developed for copper, silver, molybdenum and tungsten. Neutron cross sections which were calculated by Heinish and Mann for mobile and clustered defects in copper were applied to a wide range of fission and fusion neutron spectra. These defect cross sections were developed from the computer simulation of the production and annealing of isolated binary collision cascades. The total number of defects per cascade were normalized to the semi-empirically derived PKA cross section for the production of Frenkel pairs by selecting an appropriate recombination radius. A study of the spectral sensitivity of mobile and clustered defects reveals that the relative numbers of mobile defects will be spectrally sensitive while clustered defects will be relatively insensitive to difference between fusion and most fission neutron spectra.

40243 **Comparison of swelling for structural materials on neutron and ion irradiation.** Loomis, B.A. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 690-694(Nov-Dec 1986). (CONF-860421—).

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The swelling of V-base alloys, Type 316 stainless steel, Fe-25Ni-15Cr alloy, ferritic steels, Cu, Ni, Nb-1% Zr, and Mo on neutron irradiation is compared with the swelling for these materials on ion irradiation. The results of this comparison show that utilization of the ion-irradiation technique provides for a discriminative assessment of the potential for swelling of candidate materials for fusion reactors.

40244 **Mechanism of swelling suppression in phosphorous-modified Fe-Ni-Cr alloys.** Lee, E.H.; Mansur, L.K. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 695-702(Nov-Dec 1986). (CONF-860421—).

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Five simple alloys were ion irradiated at 948 K in an experiment designed to investigate the mechanism of swelling suppression associated with phosphorous additions. One of the alloys was the simple ternary Fe-15Ni-13Cr, another had 0.05% P added and the other three had further additions of the phosphide precipitate-forming elements Ti and/or Si. Ion irradiations were carried out with heavy ions only (Ni or Fe) or with heavy ions followed by dual heavy ions and helium. The ternary with and without P swelled readily early in dose with or without helium. The other three alloys only showed swelling in the presence of helium and exhibited a long delay in dose prior to the onset of swelling. These displayed fine distributions of Fe_2P type phosphide precipitates enhanced by irradiation. The phosphide particles gave rise to very high concentrations of stable helium filled cavities at the precipitate matrix interfaces. The results were analyzed in terms of the theory of cavity swelling. The accumulation of the critical number of gas atoms in an individual cavity is required in the theory for point defect driven swelling to begin. It is concluded that the primary mechanism leading to swelling suppression is therefore the dilution of injected helium over a very large number of cavities. It is suggested that this mechanism may offer a key for alloy design for swelling resistance in high helium environments.

40245 **Effect of helium on swelling and microstructural evolution in ion-irradiated V-15Cr-5Ti alloy.** Loomis, B.A.; Kestel, B.J.; Gerber, S.B.; Ayrault, G. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 705-712(Nov-Dec 1986). (CONF-860421—).

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The effect of helium implantation on the swelling and microstructural evolution in the V-15Cr-5Ti alloy was determined from TEM observations of the alloy after either single-ion irradiation, dual-ion irradiation, or helium implantation followed by single-ion irradiation. In addition to the TEM observations of the irradiated alloy, the effect of helium implantation on the depend-

ence of the RIS of solute atoms was determined by use of the AES, EDXS, and EELS techniques. The swelling of the alloy was negligible (<0.1%) for dual-ion irradiations at temperatures to 725°C and irradiation damage levels to 200 dpa and for single-ion irradiations at temperatures to 750°C and irradiation damage levels to 300 dpa. The morphology and distribution of irradiation-produced precipitates were distinctly different for the single- and dual-ion irradiated alloy. A helium implantation rate in the range of 5 to 9 appm He/dpa caused the accelerated growth of some helium-filled cavities in the alloy to give a bi-modal distribution of cavity sizes.

40246 **Gas accumulation at grain boundaries during 800 MeV proton irradiation of aluminium and aluminium-alloys.** Singh, B.N.; Horsewell, A.; Sommer, W.F.; Lohmann, W. (Risoe National Lab., Roskilde, Denmark; Los Alamos National Lab., NM; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). *Journal of Nuclear Materials;* **141-143**: No. B, 718-722(Nov-Dec 1986). (CONF-860421—).

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Samples of pure aluminium (99.9999%) and commercial Al-2.7%Mg (AlMg3) and Al-1.1%Mg-0.5%Si (Al6061) alloys were irradiated with 800 MeV protons at the Los Alamos Meson Physics Facility (LAMPF) at a temperature between 40-100°C to a maximum dose of 0.2 dpa. Transmission electron microscopy (TEM) showed a complete absence of voids or bubbles in the grain interiors of the aluminium and the aluminium-alloys. Bubbles were clearly visible by TEM at grain boundaries in pure Al and the AlMg3 alloy; but bubbles were not visible in the Al6061 alloy. The bubble density in the AlMg3 alloy was considerably higher than in pure Al. The amount of gas accumulation at grain boundaries was found to depend on gas generation rate, alloying and cold-work microstructure.

40247 **Migration and coalescence of tritium-induced helium bubbles on grain boundaries in nickel.** Mintz, J.M.; Sattler, M.L. (Sandia National Labs., Livermore, CA; Lawrence Berkeley Lab., CA). *Journal of Nuclear Materials;* **141-143**: No. B, 727-730(Nov-Dec 1986). (CONF-860421—). Contract AC04-76DP00789.

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The migration and coalescence of sub-critical helium bubbles on grain boundaries during creep in nickel has been studied. Helium was introduced without radiation damage by tritium decay following gas phase charging. An initial population of helium bubbles was then stabilized by suitable heat treatment. Interrupted creep tests, followed by sectioning and quantitative metallography, revealed that the initial fine scale distribution of small (2-4 nm) bubbles quickly coarsened during primary creep until the critical size for growth by vacancy absorption was attained, resulting in a fixed distribution of cavity nuclei. The characteristics of that distribution, including average spacing and stress dependence, strongly supported the Beere migration and coalescence model. Thin film transmission microscopy of interrupted creep specimens provided additional supporting evidence.

40248 **Spectral effects in low-dose fission and fusion neutron irradiated metals and alloys.** Heinisch, H.L.; Atkin, S.D.; Martinez, C. (Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. B, 807-815(Nov-Dec 1986). (CONF-860421—). Contract AC06-76FF02170.

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Flat miniature tensile specimens were irradiated to neutron fluences up to $9x10^{22}$ n/m² in the RTNS-II and in the Omega West Reactor. Specimen temperatures were the same in both environments, with runs being made at both 90°C and 290°C. The results of tensile tests on AISI 316 stainless steel, A302B pressure vessel steel and pure copper are reported here. The radiation-induced changes in yield strength as a function of neutron dose in each spectrum are compared. The data for 316 stainless steel correlate well on the basis of displacements per atom (dpa) while those for copper and A302B do not. In copper the ratio of fission dpa to 14 MeV neutron dpa for a given yield stress change is about three to one. In A302B pressure vessel steel this ratio is more than three at lower fluences, but the yield stress data for fission and 14 MeV neutron-irradiated A302B steel appears to coalesce or intersect at the higher fluences.

40249 **Development of defects from displacement cascade damage in low temperature D-T neutron-irradiated metals.** Shimomura, Y.; Fukushima, H.; Guinan, M.W.; Kiritani, M. (Hiroshima Univ., Japan; Lawrence Livermore National Lab., CA; Hokkaido Univ., Sapporo, Japan). *Journal of Nuclear Materials;* **141-143**: No. B, 816-823(Nov-Dec 1986). (CONF-860421—).

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Pre-thinned pure metal foils were irradiated with D-T neutrons below 20 K and transferred in a cryostat to an electron microscope for observation of the displacement damage cascades at 130 K. Subsequently, the specimens were annealed isochronally to observe cascade relaxation. Pure gold was examined most extensively in the present experiment. After the very low fluence ($6x10^{19}$ n/m²), the defects observed at low temperature were interstitial loops while vacancy clusters were not observed. These defects may be retained in an unrelaxed structure. The interstitial loops disappeared partially with an increase of annealing temperature. At the low fluence of $3x10^{20}$ n/m², interstitial loops grew significantly at 220 K to 250 K and shrunk at 300 K to 430 K. Small dotted clusters (vacancy stacking fault tetrahedra) appeared at 300 K near existing interstitial loops and some grew up until 520 K. At the medium fluence of $6x10^{21}$ n/m², many defects observed at 130 K showed the typical triangular contrast of stacking fault tetrahedra. Ninety-five percent of the defects observed at 130 K were found to be of vacancy type by the 2 1/2 D method. Those defects were annealed significantly at room temperature. Visible vacancy clusters seem to be formed only by overlap of cascades during low temperature irradiation. Small interstitial clusters which remain in specimens move to vacancy clusters during the room temperature annealing. At medium fluence, clusters of both vacancy and interstitial type were formed in nickel, while almost all defects were of an interstitial type in copper.

40250 **Helium production in HFIR-irradiated pure elements.** Kneff, D.W.; Oliver, B.M.; Skowronski, R.P.; Greenwood, L.R. (Rockwell International Corp., Canoga Park, CA; Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 824-828(Nov-Dec 1986). (CONF-860421—).

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Helium measurements have been made for Ni, Fe, Ti, Nb, Cr, and Cu samples from several different fusion materials irradiations in the mixed-spectrum High Flux Isotope Reactor (HFIR). The results are compared with helium predictions based on neutron energy spectrum measurements and the ENDF/B-V Gas Production File. The comparisons indicate good agreement for Ni, Fe, and Cr, but cross-section discrepancies were observed for helium production by fast neutrons in Ti, Nb, and Cu. Nickel and copper exhibit enhanced helium production at high neutron fluences, and there may also be a small enhancement for iron. This work demonstrates the importance of measuring helium production in materials of interest over the full range of neutron fluences used in fusion materials tests. The combination of measurements and predictions from well-characterized neutron fields can then be used to provide accurate helium estimates for materials irradiations.

40251 **Cascade-overlap effect on defect structure evolution revealed by repeated D-T neutron irradiation.** Yoshiie, T.; Kojima, S.; Kiritani, M.; Shimomura, Y.; Guinan, M.W. (Hokkaido Univ., Sapporo, Japan; Hiroshima Univ., Japan; Lawrence Livermore National Lab., CA). *Journal of Nuclear Materials;* **141-143**: No. B, 860-864(Nov-Dec 1986). (CONF-860421—).

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Two systematic neutron irradiation experiments have been carried out in gold and copper to investigate the effect of cascade overlap on the damage structure evolution. One was the observation of the development of defect structure as a function of irradia-

tion dose from 10^{19} n/m^2 to 10^{22} n/m^2. The other was a repeated irradiation and observation, in which an identical part of the specimen was observed after several irradiations, to obtain more direct information on the formation and evolution of defect structures from displacement cascade. Point defect clusters forming closely spaced groups, which are formed from displacement subcascades, have been confirmed. These closely spaced groups have revealed themselves by the survival of a large number of vacancy clusters in the cascade with increasing irradiation dose by the effective annihilation of interstitials at defect clusters formed by previous irradiation.

40252 **Effects of solute on damage production and recovery in zirconium.** Zee, R.H.; MacEwen, S.R.; Birtcher, R.C. (Atomic Energy of Canada Ltd., Chalk River, Ontario; Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 870-873(Nov-Dec 1986). (CONF-860421—).

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Dilute zirconium-based alloys and pure zirconium were irradiated at 10 K with spallation neutrons at IPNS. Four types of alloys, viz., Zr-Ti, Zr-Sn, Zr-Dy and Zr-Au, each with three different concentrations of solute were investigated. Low-temperature resistivity damage rates were enhanced by the presence of each of the four solutes. The greatest enhancement was produced by Au while the least enhancement was produced by Dy. Within each alloy group, damage production increased with increasing concentration but at a decreasing rate. Post-irradiation annealing experiments, up to 400 K, showed that all four solutes suppressed recovery due to interstitial migration which is indicative of interstitial trapping by the solutes. Vacancy recovery was also suppressed by the presence of Sn, Dy or Au. The effect of Ti was to shift this stage to lower temperature. A clear correlation between the results and solute size was not detected.

40253 **Damage production and recovery in zirconium alloys irradiated with fusion neutrons.** Zee, R.H.; Guinan, M.W.; Huang, J.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario; Lawrence Livermore National Lab., CA). *Journal of Nuclear Materials;* **141-143**: No. B, 874-877(Nov-Dec 1986). (CONF-860421—).

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Three zirconium specimens, one with 952 appm Ti, one with 1352 appm Sn, and one with 917 appm Au, were irradiated at 4.2 K with 14.8 MeV neutrons to an average fluence of 3.5×10^{21} n/m^2. Results show that the presence of any of these solutes suppresses initial damage production when compared to unalloyed zirconium. Furthermore, these solutes also eliminate the pronounced curvature in the damage-rate curve found for pure zirconium. Comparison with other studies suggests that recoil energy plays an important role in damage production, a feature not found in cubic metals. Annealing data indicate that the addition of Ti or Au reduces interstitial recovery, whereas Sn has little influence on this stage. The magnitude of recovery by vacancy motion is suppressed by Sn or Au. However, the effect of Ti is to lower the peak temperature of this stage.

40254 **Effects of low doses of 14 MeV neutrons on the properties of various commercial copper alloys.** Heinisch, H.L.; Martinez, C. (Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. B, 883-887(Nov-Dec 1986). (CONF-860421—). Contract AC06-76FF02170.

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Miniature tensile specimens of high purity copper and five copper alloys were irradiated with D-T fusion neutrons in the RTNS-II to fluences up to 2.5×10^{22} n/m^2 at 90°C and 290°C. The series of alloys includes solution-strengthened, precipitate-strengthened and dispersion-strengthened alloys. To compare fission and fusion neutron effects, some of the alloys were also irradiated at the same temperatures to similar damage levels of the Omega West Reactor. Tensile tests were performed at room temperature, and the radiation-induced changes in tensile properties are examined as functions of fluence and displacements per atom (dpa). All the alloys sustain less irradiation-induced strengthening than pure copper. In contrast to pure copper, the effects of fission and fusion neutrons on the yield stress changes in the copper alloys correlate well on the basis of dpa.

40255 **Irradiation disordering and ordering of Cu_3Au by fusion neutrons.** Huang, J.S.; Guinan, M.W.; Hahn, P.A. (Lawrence Livermore National Lab., CA). *Journal of Nuclear Materials;* **141-143**: No. B, 888-892(Nov-Dec 1986). (CONF-860421—).

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Ordered and partially ordered Cu_3Au alloys (S=0.30-0.99) have been irradiated at 4 K and 300 K with fusion neutrons at RTNS-II. The disordering rate was measured by monitoring electrical resistivity. The analysis of 4 K irradiations and a comparison with fission reactor irradiations indicated that the disordering rate depended upon the long-range order parameter, S. The disordering is defined by $dS/dphit = -S(k_1 - k_2 S)$, where k_1 and k_2 are scaled with damage energy. The results of 300 K irradiation indicated that reordering competed significantly with disordering in the partially ordered sample. Compared to the results of 4 K irradiation, the net disordering rate at 300 K was higher than that at 4 K. This difference and the dependence of disordering rate on S is discussed in terms of the effect of disorder and thermal displacements on cascade cooling processes.

40256 **Helium effects on void formation in 9Cr-1MoVNb and 12Cr-1MoVW irradiated in HFIR.** Maziasz, P.J.; Klueh, R.L.; Vitek, J.M. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 929-937(Nov-Dec 1986). (CONF-860421—).

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Up to 2 wt% Ni was added to 9Cr-1MoVNb and 12Cr-1MoVW ferritic steels to increase helium production by transmutation during HFIR irradiation. The various steels were irradiated to proportional to 39 dpa. Voids were found in all the undoped and nickel-doped steels irradiated at 400°C, most of them at 500°C, but not in any of them at 300 or 600°C. Bubble formation, however, was increased at all temperatures in the nickel-doped steels. Maximum void formation was found at 400°C, but swelling remained less than 0.5% even with up to 440 appm He. Irradiation at 300 to 500°C caused dissolution of as-tempered $M_{23}C_6$ precipitates and coarsening of the lath/subgrain structure in the 9-Cr steels, whereas the microstructure generally remained stable in the 12-Cr steels. Irradiation in this temperature range also caused compositional changes in the as-tempered MC phase in all the steels, and produced combinations of fine M_6C, G-phase, and M_2X precipitates in various steels. The subgrain boundaries appear to be strong sinks that enhance resistance to void formation. Higher helium production during irradiation appears to shorten the incubation period for void formation. The effects of helium on steady state void swelling behavior, however, remain unknown.

40257 **Microstructural development of PCAs irradiated in HFIR at 300 to 400°C.** Tanaka, M.P.; Hishinuma, A.; Hamada, S.; Maziasz, P.J. (Japan Atomic Energy Research Institute, Tokai, Ibaraki; Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 943-947(Nov-Dec 1986). (CONF-860421—).

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Microstructural developments were determined on solution-annealed (SA) and cold-worked (CW) JPCA and U.S. PCAs irradiated in the High Flux Isotope Reactor (HFIR) at 300 and 400°C. Irradiation produced damage levels of about 10 and 34 dpa and helium concentrations of around 580 and 2500 appm respectively. High concentrations of fine bubbles and MC precipitates, as well as Frank faulted loops, were observed in both SA and CW PCAs. Mutual stability of the MC particles and associated fine bubbles contributed to the extension of the transient regime of swelling to higher fluence. The irradiation responses of JPCA and U.S.-PCA were similar in the HFIR, despite minor compositional differences (P,B) between the two materials. Useful fusion applications of SA-PCA as well as CW-PCA in the 300 to 400°C temperature range are suggested from these data.

40258 **Saturation of the DBTT shift of irradiated 12Cr-1MoVW with increasing fluence.** Vitek, J.M.; Corwin, W.R.; Klueh, R.L.; Hawthorne, J.R. (Oak Ridge National Lab., TN; Materials Engineering Associates, Inc., Lanham, MD). *Journal of Nuclear Materials;* **141-143**: No. B, 948-953(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

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Irradiation of ferritic steels often results in an increase in the ductile-to-brittle transition temperature (DBTT), sometimes well in excess of 100°C, and also a substantial decrease in the upper shelf energy (USE). Two irradiation experiments were conducted to determine the fluence dependence of this degradation in impact properties. Identical subsize Charpy specimens of 12Cr-1MoVW steel were irradiated in the University of Buffalo Reactor (UBR) at 300°C to a fluence of 0.86×10^{24} n/m² (E>0.1 MeV) and in the High Flux Isotope Reactor (HFIR) at 300 and 400°C to a fluence of proportional to 1×10^{26} n/m² (E>0.11 MeV). Impact testing indicated that the DBTT was increased by irradiation at 300°C by 36 (UBR) and 164°C (HFIR). Corresponding decreases in the USE were 13 and 33%, respectively. Irradiation in HFIR at 400°C led to an increase in the DBTT of 217°C and a 50% drop in the USE. Tests on aged but unirradiated control materials indicated aging alone has an insignificant effect on the impact properties. The results show that the major portion of the irradiation embrittlement at 300°C occurs for fluences beyond 1×10^{24} n/m². Comparison of the results with data in the literature shows that the greatest effect on the impact properties of 12Cr-1MoVW steels results after irradiation in the temperature range of 300 to 400°C. Finally, a possible detrimental influence of small amounts of helium is noted and discussed.

40259 **Postirradiation tensile behavior of nickel-doped ferritic steels.** Klueh, R.L.; Maziasz, P.J.; Vitek, J.M. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 960-965(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Tensile specimens of normalized-and-tempered 9Cr-1MoVNb, 9Cr-1MoVNb-2Ni, 12Cr-1MoVW, 12Cr-1MoVW-1Ni, and 12Cr-1MoVW-2Ni were irradiated in the Experimental Breeder Reactor (EBR-II) at 390, 450, 500, and 550°C to displacement-damage levels of approximately 16 dpa. The nickel in these steels was added to produce helium during irradiation in a mixed-spectrum reactor. Irradiation of these steels in the fast-spectrum EBR-II, where little helium is formed, helped determine the effect of helium on properties. The nickel-doped steels were stronger prior to irradiation due to a lower tempering temperature. After irradiation, the properties of the steels with and without nickel were similar, indicating that the presence of nickel did not affect the behavior of the steels during irradiation. These fast-reactor results indicate that it is feasible to use the nickel-doped ferritic steels to study helium effects.

40260 **Fatigue behavior of irradiated helium-containing ferritic steels for fusion reactor applications.** Grossbeck, M.L.; Vitek, J.M.; Liu, K.C. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 966-972(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The martensitic alloys 12Cr-1MoVW and 9Cr-1MoVNb have been irradiated in the High Flux Isotope Reactor (HFIR) and subsequently tested in fatigue. In order to achieve helium levels characteristic of fusion reactors, the 12Cr-1MoVW was doped with 1 and 2% Ni, resulting in helium levels of 210 and 410 appm at damage levels of 25 dpa. The 9Cr-1MoVNb was irradiated to a damage level of 3 dpa and contained less than 5 appm He. Irradiations were carried out at 55°C and testing at 22°C. No significant changes were found in 9Cr-1MoVNb upon irradiation at this damage level, but effects that could possibly be attributed to helium were found in 12Cr-1MoVW. Levels of 210 and 410 appm He produced cyclic strengthening of 29 and 345% over unirradiated nickel-doped materials, respectively. This cyclic hardening, attributable largely to helium, resulted in degradation of the cyclic life. However, the fatigue life remained comparable to or better than unirradiated 20%-cold-worked 316 stainless steel.

40261 **Modification of the grain boundary microstructure of the austenitic PCA stainless steel to improve helium embrittlement resistance.** Maziasz, P.J.; Braski, D.N. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 973-977(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Grain boundry MC precipitation was produced by a modified thermal-mechanical pretreatment in 25% cold-worked (CW) austenitic prime candidate alloy (PCA) stainless steel prior to HFIR irradiation. Postirradiation tensile results and fracture analysis showed that the modified material (B3) resisted helium embrittlement better than either solution annealed (SA) or 25% CW PCA irradiated at 500 to 600°C to proportional to 21 dpa and 1370 appm He. PCA SA and 25% CW were not embrittled at 300 to 400°C. Grain boundary MC survives in PCA-B3 during HFIR irradiation at 500°C but dissolves at 600°C; it does not form in either SA or 25% CW PCA during similar irradiation. The grain boundary MC appears to play an important role in the helium embrittlement resistance of PCA-B3.

40262 **Radiation-induced segregation in HT-9 martensitic steel.** Clausing, R.E.; Heatherly, L.; Rowcliffe, A.F.; Farrell, K.; Faulkner, R.G. (Oak Ridge National Lab., TN; Loughborough Univ. of Technology, England). *Journal of Nuclear Materials;* **141-143**: No. B, 978-981(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Miniature notched-bar specimens of normalized and tempered HT-9 were neutron irradiated to proportional to 13 dpa and broken at liquid nitrogen temperatures in a UHV chamber. Fracture surfaces were analyzed using scanning Auger electron spectroscopy. Following irradiation at 410°C, the fracture surface contained a small number of large relatively smooth facets, which are thought to be prior austenite grain boundaries. Strong segregation of Ni, Cr, Si, and P was detected at these surfaces, the remainder of the fracture surface showing no evidence of segregation. At irradiation temperatures of 520°C and 565°C, there was relatively little segregation and none was found in thermal controls.

40263 **Effect of preinjected helium on the response of V-20Ti pressurized tubes to neutron irradiation.** Vitek, J.M.; Braski, D.N.; Horak, J.A. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 982-986(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Vanadium-20% titanium tubes, pressurized to stresses of 34 and 39 MPa, were irradiated in the Experimental Breeder Reactor (EBR-II) at 700°C to a fluence of 3.9×10^{26} n/m², corresponding to a displacement damage level of 22 dpa. Sections of the tubes were injected with 15 appm He prior to irradiation to determine the effect of helium on the microstructural and creep response of this alloy to irradiation. It was found that helium promoted cavity formation, primarily within existing precipitates, but total swelling remained low. Under some conditions, an apparent enhanced creep deformation due to the presence of helium was found. The results suggest that the increase in creep deformation in the presence of helium may be very sensitive to stress.

40264 **Complementary AES and AEM of grain boundary regions in irradiated γ′-strengthened alloys.** Farrell, K.; Clausing, R.E.; Heatherly, L.; Kishimoto, N.; Lehmann, G.L. (Oak Ridge National Lab., TN; National Research Institute for Metals, Sakura, Ibaraki, Japan; Oak Ridge Associated Universities, Inc., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 991-995(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Two microchemical analysis techniques are used to measure solute segregation at grain boundaries in two γ′-strengthened, fcc Fe-Ni-Cr alloys that display radiation-induced intergranular fracture. Scanning Auger electron spectroscopy (AES) of grain boundary fracture surfaces and analytical electron microscopy (AEM) of intact grain boundaries using energy-dispersive X-ray spectroscopy

show good agreement on the nature and extent of segregation. The elements Ni, Si, Ti and Mo are found to accumulate in G, Laves and γ' phases on the grain boundaries. Segregation of P is detected by AES. The complementary features of the two analytical techniques are discussed briefly.

40265 **Program of United States-Japan collaborative testing in HFIR and ORR.** Scott, J.L.; Grossbeck, M.L.; Rowcliffe, A.F.; Hishinuma, A.; Kondo, T.; Tanaka, M.P. (Oak Ridge National Lab., TN; Japan Atomic Energy Research Institute, Tokai, Ibaraki). *Journal of Nuclear Materials;* **141-143**: No. B, 996-999(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The objective of the program of US-Japan collaborative testing in HFIR and ORR is to investigate the response of austenitic stainless steels to levels of neutron radiation damage anticipated in fusion reactors. Emphasis is placed on United States and Japanese Type 316 stainless steels and prime candidate alloys (PCA), but improved alloys are also included. The program consists of eight HFIR target capsules and two ORR spectral tailoring capsules with test temperatures of 60 to 600°C and fluences of 30 to 50 dpa. Helium contents after irradiation match or exceed those produced in a fusion reactor at the same dpa level. Types of data to be obtained include tensile, fatigue, crack growth, irradiation creep, swelling, and microstructural evolution. Five HFIR capsules have been irradiated, and testing is under way. Less than 1% swelling is observed for Type 316 stainless steel and PCA alloys irradiated to about 30 dpa at 300 to 500°C.

40266 **HFIR irradiation facilities improvements - the HIFI Project.** Hicks, G.R.; Montgomery, B.H.; Thoms, K.R.; West, C.D. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 1018-1024(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The High-Flux Isotope Reactor (HFIR) has outstanding neutronics characteristics for materials irradiation, but some relatively minor aspects of its mechanical design severely limit its usefulness for that purpose. In particular, though the flux trap region in the center of the annular fuel elements has a very high neutron flux, it has no provision for instrumentation access to irradiation capsules. The irradiation positions in the beryllium reflector outside the fuel elements also have a high flux; however, although instrumented, they are too small and too few to replace the facilities of a materials testing reactor. To address these drawbacks the HFIR Irradiation Facilities Improvement (HIFI) Project, now under way and scheduled for completion in mid-1987, consists of modifications to the reactor vessel cover, internal structure, and reflector. Instrumentation access will be provided to the flux trap region, and the number of materials irradiation positions in the removable beryllium will be increased from four to eight, each with almost twice the available experimental space of the present ones.

40267 **Use of the low-temperature neutron irradiation facility for fusion materials research.** Coltman, R.R. Jr.; Kerchner, H.R.; Klabunde, C.E.; Young, F.W. Jr. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 1054-1056(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The Low-Temperature Neutron Irradiation Facility (LTNIF), now constructed and currently being evaluated, will provide high radiation intensities and special environmental and testing conditions for qualified experiments at no cost to users. The LTNIF will be of interest for both basic and applied research on fusion reactor materials. A general description and major specifications of the facility are presented along with recent results of the performance tests. In addition, a description is given of the procedure and experimental assemblies needed to perform experiments in the LTNIF.

40268 **Design of a single variable helium effects experiment for irradiation in FFTF using alloys enriched in nickel-59.** Simons, R.L.; Brager, H.R.; Matsumoto, W.Y. (Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. B, 1057-1060(Nov-Dec 1986). (CONF-860421—). Contract AC06-76FF02170.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Nickel enriched in Ni-59 was extracted from the fragments of a fracture toughness specimen of Inconel 600 irradiated in the Engineering Test Reactor (ETR). The nickel contained 2.0% Ni-59. Three heats of austenitic steel doped with Ni-59 were prepared and inserted in the Materials Open Test Assembly (MOTA) of the Fast Flux Test Facility (FFTF). The experiment is single variable in helium effects because chemically identical alloys without Ni-59 are being irradiated side by side with the doped material. The doped alloys will produce 10-100 times more helium than the control alloys. The materials include ternary and quaternary alloys in the form of transmission electron microscope (TEM) discs and miniature tensile specimens. The helium-to-dpa (displacements per atom) ratio will be in the range 5 to 35 and will be nearly constant throughout the irradiation. The exposures will range from 0.25 to 50 dpa over the duration of the experiment. The irradiation temperatures cover the range of 360-600°C.

40269 **RTNS-II fusion materials irradiation facility.** Heikkinen, D.W.; Davis, J.C.; Massoletti, D.J.; Short, D.W.; Tuckerman, D.B. (Lawrence Livermore National Lab., CA). *Journal of Nuclear Materials;* **141-143**: No. B, 1061-1063(Nov-Dec 1986). (CONF-860421—). Contract W-7405-ENG-48.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The Rotating Target Neutron Source (RTNS-II) facility provides an intense source of 14 MeV neutrons for the fusion energy programs of Japan and the United States. Each of the two identical accelerator-based neutron sources is capable of providing source strengths in excess of 3×10^{13} n/s using deuteron beam currents up to 150 mA. At the present time, the facility operates a minimum total of twenty shifts (8 h) per week using both neutron sources. Because of funding cut-backs, future operations will be limited to one neutron source. The possibility exists to increase neutron output by combining the high voltage power supplies, thereby increasing the current capability of the operating neutron source. This would allow approximately a factor of three increase in neutron output. Using existing equipment, an ion source test stand has been constructed to improve ion source output. Conceptual design studies have been made concerning a factor of ten increase in neutron output. Detailed studies of needed target improvements have been made and will be discussed. The present status of the facility, as well as the various upgrade options, will be described in detail.

40270 **Prospects for reduced activation alloys.** Doran, D.G.; Mann, F.M.; Rowcliffe, A.F. (Westinghouse Hanford Co., Richland, WA; Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 1074-1080(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The purpose of this paper is to describe the framework within which the development of alloys exhibiting reduced activation is being pursued in the US and to survey the current status and future prospects of this effort. The goal is to reduce activation to a level precluding the need for geologic disposal in order to help make fusion power environmentally and economically attractive. Initial efforts at reducing activation are aimed at replacing problem elements - especially Nb, Mo, and Ni - with more benign elements in analogues of structural alloys such as Ti-modified 316 stainless steel, the ferritic/martensitic steels containing 9-12% Cr, and the lower Cr (2%) ferritic/bainitic steels. The intrinsically low activation vanadium alloys are also under study; these are not common structural materials, so a data base is only slowly accumulating. Although this work is at an early stage, it provides evidence for optimism that the goal can be met.

40271 **Development of ferritic steels for reduced activation: The US program.** Klueh, R.L.; Gelles, D.S.; Lechtenberg, T.A. (Oak Ridge National Lab., TN; Westinghouse Hanford Co., Richland, WA; GA Technologies, Inc., San Diego, CA). *Journal of Nuclear Materials;* **141-143**: No. B, 1081-1087(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The Cr-Mo ferritic (martensitic) steels are candidates for the structural components of fusion reactors. Irradiation of such steels in a fusion environment produces long-lived radioactive isotopes, which lead to difficult radioactive waste disposal problems once the structure is removed from service. Such problems could be reduced by using steels that contain only elements that produce radioactive isotopes that decay to low levels in a reasonable time (tens of years instead of hundreds or thousands of years). The US Department of Energy has a program to develop steels to meet the criteria for shallow land burial as opposed to deep geologic storage. A review of the alloy development programs indicates that ferritic steels that meet these criteria can be developed.

40272 **Alloying and impurity effects in vanadium-base alloys.** Diercks, D.R.; Loomis, B.A. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. B, 1117-1124(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Vanadium-base alloys offer a number of significant advantages over other alloy systems for fusion reactor structural applications. However, the properties and performance of vanadium are strongly influenced by the choice of alloying additions and the presence of impurity elements, and these effects are reviewed in this paper. In particular, contraints imposed by neutron-activation considerations upon possible alloying additions and permissible levels of impurities are discussed, and typical impurity levels resulting from reduction and refining operations are summarized. The effects of alloying additions and impurities upon mechanical properties are also reviewed, with particular attention given to recent observations on the intergranular segregation of sulfur and other impurities. Effects on corrosion/compatibility and fabrication properties are also summarized. Finally, consideration is given to future directions in alloy optimization, in view of recent results on the apparent neutron-irradiation and helium embrittlement of certain V-Cr-Ti alloys.

40273 **Effect of neutron irradiation on vanadium alloys.** Braski, D.N. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. B, 1125-1131(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Neutron-irradiated vanadium alloys were evaluated for their susceptibility to irradiation hardening, helium embrittlement, swelling, and residual radioactivity, and the results were compared with those for the austenitic and ferritic stainless steels. The VANSTAR-7 and V-15Cr-5Ti alloys showed the greatest hardening between 400 and 600°C while V-3Ti-Si and V-20Ti had lower values that were comparable to those of ferritic steels. The V-15Cr-5Ti and VANSTAR-7 alloys were susceptible to helium embrittlement caused by the combination of weakened grain boundaries and irradiation-hardened grain matrices. Specimen fractures were entirely intergranular in the more severe instances of embrittlement. The V-3Ti-1Si and V-20Ti alloys were most resistant to helium embrittlement. Except for VANSTAR-7 irradiated to 40 dpa at 520°C, all of the vanadium alloys exhibited low swelling that was similar to the ferritic steels. Swelling was greater in specimens that were pre-implanted with helium using the tritium trick. The radioactive decay characteristics of vanadium alloys will simplify waste diposal for spent reactor components, compared to the requirements for conventional ferrous alloys.

99 GENERAL AND MISCELLANEOUS

40274 **(DOE/ER—0296) University research and scientific education programs of the US Department of Energy.** (USDOE Office of Energy Research, Washington, DC. Office of Field Operations Management). Sep 1986. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012825.

Annually, the Department supports an average of 350 postdoctoral researchers who conduct full-time research at the major DOE laboratories. The Department also supports 3000 to 3500 graduate students each year on university research projects. Twelve hundred undergraduate science and engineering students are supported each summer in both research and instructional programs at over 30 DOE laboratories and contractor facilities. DOE also supports programs and activities involving secondary school science teachers and students.

40275 **(DOE/MA—0298) DOE Real Property: A yearly statistical handbook.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). Jul 1987. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012949.

Information is arranged from broad Department levels through more narrow site level tables. Sections are arranged by land holdings, followed by buildings, and lastly, by other structures and facilities. Other structures and facilities are real property components such as exterior utilities, roads, parking lots, exterior lighting, storage tanks, railroad tracks, and other similar items.

40276 **(LBL-PUB—615) Lawrence Berkeley Laboratory, Jackson State University, Ana G. Mendez Educational Foundation Consortium: Progress report, October 1985-September 1986.** (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87012028.

Seventeen student papers are included, treating various topics in computer languages and software, physics, combustion and atmosphere, and biology. All are processed separately for the data base. (DLC)

40277 **(SAND—85-0917) Plasmoid propagation.** Lockner, T.R.; Lipinski, R.J.; Miller, R.B. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1985. Contract AC04-76DP00789. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86015384.

A report is made on an investigation into the propagation of plasmoids. Plasmoid is the term used for a plasma moving through space as a body. Plasmoids have the potential to play important roles in target discrimination and reentry vehicle kill in the Strategic Defense Initiative. An important uncertainty regarding this potential is whether plasmas can propagate through the vacuum of space and across the earth's magnetic field without appreciable divergence or deflection. An additional concern is how deeply plasmoids can penetrate into the earth's ionosphere and upper atmosphere. Several plasma configurations are suggested that have low-divergence potential. Simple models for the plasmoid behavior are developed and the results of calculations are presented.

9901 Management

REFER ALSO TO CITATION(S) 39561, 40175

40278 **(BNL—39992) Research quality: The R & D community responds quality assurance from a researcher's perspective.** Thomas, R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870950—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012478.

From 14. annual national American Society for Quality Control; Las Vegas, NV, USA (14 Sep 1987).

Real basic scientific research principally is individual human expression, with no known proven techniques or procedures to achieve its purpose. For this reason present day quality assurance

techniques are only applicable to the myriad of measurements, procedures, constructions, etc., which are carried out in support of basic scientific research, but which are themselves not basic scientific research.

40279 **(CONF-8607332—1) Advancement of research for the 1990s, as seen by the German Industry.** Kreklau, C. (Bundesverband der Deutschen Industrie e.V., Koeln (Germany, F.R.)). 1986. 30p. (In German). NTIS (US Sales Only), PC A03. File Number DE87770209.

From 10. VDI colloquium: advancement of research for the 1990's, as seen by the German industry; Duesseldorf, F.R. Germany (8 Jul 1986).

The mastering of the challenge of the 90s essentially depends on research and technology policies. The deadlining of a number of financing programs, the restrictive EEC measures controlling national R and D programs as well as the agitating subvention debate are already now forcing the far-sighted development of models and ideas to determine the research and technology policies of the coming decade. Emphasis ought to be placed both on the further development of experienced schemes and vehicles and on the search for an investigation into new vehicles. From the point of view of the industrial domain of the Federal Republic of Germany priority must be given to the improvement of the decor and infrastructural factors determining research, development and innovation activities. The successful improvement of the latter will help to reduce specific financing programs. The market requires the motives of research and technology programs to be unequivocally defined. One of the decisive problems to be coped with consists in the handling and instrumentation of programs.

40280 **(KFK—4207) Central Safety Department. Annual report 1986.** Kiefer, H.; Koenig, L.A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Mar 1987. 306p. (In German). NTIS, PC E99; Available from NTIS as TIB/B87-10132.

The Safety Officer and the Security Officer are responsible for radiation protection and technical safety, both conventional and nuclear, for the physical protection as well as the safeguards of nuclear materials and radioactive substances within the Kernforschungszentrum Karlsruhe GmbH (KfK). To fulfill these functions they rely on the assistance of the Central Safety Department. The Central Safety Department is responsible for handling all problems of radiation protection, safety and security of the institutes and departments of the Karlsruhe Nuclear Research Center, for waste water activity measurements and environmental monitoring of the whole area of the Center, and for research and development work mainly focusing on nuclear safety and radiation protection measures. The r+d work concentrates on the following aspects: physical and chemical behavior of biologically particularly active radionuclides, behavior of HT in the air/plant/soil system, biophysics of multicellular systems, improvement in radiation protection measurement and personnel dosimetry. The report gives details of the different duties, indicates the results of 1986 routine tasks and reports about results of investigations and developments of the working groups of the Department.

40281 **(RISO-M—2633) Accelerator Department annual progress report 1 January-31 December 1986.** (Risoe National Lab., Roskilde (Denmark)). Feb 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751933.

A description is given of research in the fields of reaction kinetics, physical dosimetry, radiation physics and technological application of radiation and irradiation technology, as well as of the operation of various irradiation facilities.

40282 **(UCRL—96738) Getting the requirements: Techniques and experiences capturing requirements for several real-time applications.** Zucconi-Rojas, L. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 13p. (CONF-870889—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010805.

From 12. structural methods conference; Chicago, IL, USA (3 Aug 1987).

This paper discusses techniques used and experiences gained while gathering and documenting the functional requirements for several control systems and one engineering database system. This work was performed in the Atomic Vapor Laser Isotope Separation and Security programs at Lawrence Livermore National Laboratory over a period of three years. Teams of from one to four engineers gathered requirements for a large laser control system, several separator control and diagnostic systems, a security system, and an engineering database system. These systems required gathering requirements data from physicists, electrical, mechanical and material engineers, and in the case of one security application system, police officers. The paper discusses team structure, the advantages of larger teams and problems with one person teams. It defines the interview, document, feedback and critique cycle used for requirements acquisition.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 39352, 39441, 40318

40283 **(CONF-8706115—2) High-performance neural networks.** Dress, W.B. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010591.

From Rochester FORTH conference; Rochester, NY, USA (9 Jun 1987).

The new Forth hardware architectures offer an intermediate solution to high-performance neural networks while the theory and programming details of neural networks for synthetic intelligence are developed. This approach has been used successfully to determine the parameters and run the resulting network for a synthetic insect consisting of a 200-node "brain" with 1760 interconnections. Both the insect's environment and its sensor input have thus far been simulated. However, the frequency-coded nature of the Browning network allows easy replacement of the simulated sensors by real-world counterparts.

40284 **(EIR—618) Linear multistep algorithms with derivatives of order higher or equal one for the integration of ordinary, explicit differential equations.** Hirschmann, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar 1987. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702445.

The present report is concerned with the general properties of linear multistep algorithms for the solution of the initial value problem with ordinary, explicit first order differential equations. The aim of this work is the expansion of the formalism to algorithms in which derivatives of an arbitrary order with respect to the independent variable may appear. A list of all algorithms with the property of stiff stability, containing second order derivatives on up to 5 steps is presented. We mention sufficient and easily verifiable conditions for the stiff stability of a certain class of algorithms. A careful explanation of the canonical representations of predictor-corrector methods, in particular of the Nordsieck vector representation, is given on very general premises. An implementation of algorithms with fixed leading coefficients is described and several proposals for the computation of improved start values of the corrector iteration in stiff problems are made. A new integration program was written which makes use of algorithms with second order derivatives in Nordsieck vector representation. We communicate some first results of comparative computations with this program.

40285 **(LA-UR—86-4356) Experiences and results multitasking a hydrodynamics code on global and local memory machines.** Mandell, D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-870831—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003759.

From International conference on parallel processing; St. Charles, IL, USA (17 Aug 1987).

A one-dimensional, time-dependent Lagrangian hydrodynamics code using a Godunov solution method has been multitasked for the Cray X-MP/48, the Intel iPSC hypercube, the Alliant FX series and the IBM RP3 computers. Actual multitasking results have been obtained for the Cray, Intel and Alliant computers and simulated results were obtained for the Cray and RP3 machines.

The differences in the methods required to multitask on each of the machines is discussed. Results are presented for a sample problem involving a shock wave moving down a channel. Comparisons are made between theoretical speedups, predicted by Amdahl's law, and the actual speedups obtained. The problems of debugging on the different machines are also described.

40286 **(LA-UR—87-1563) A CAMAC system controlled by an IBM AT computer for time-resolved spectroscopy.** Lindquist, L.O.; Moss, C.E. (Santa Fe Energy Research Corp., NM (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870552—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010111.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

An IBM AT computer interfaced to a small CAMAC system offers considerable power without the complexity and expense of a large general-purpose system. Our system for time-resolved spectroscopy features menu-driven FORTRAN-based software; high-resolution and high-speed (8K channels, 5-μs fixed dead time) ADCs; segmentable histogram memories (24-bit counts) with large memory space for many histogram segments; independently variable separate histogram dwell times; remote control via a CAMAC serial highway; and ground isolation between the data acquisition equipment and control computer by means of fiber optics.

40287 **(LBL—23173) Interactive simulation of high resolution electron micrographs.** Kilaas, R. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870862—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010255.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Recent advances in computer hardware now allows image simulation of high resolution transmission electron microscope images to be carried out in a matter of minutes with outputs on high resolution video monitors. These "near real time" calculations have produced an emphasis on interactive software that allows changes to both the atomic model and microscope parameters. This has resulted in a set of programs being written at the National Center for Electron Microscopy (NCEM). These programs are described and the factors receiving the most attention are listed. This attention to user interface, flexibility, expansion possibilities, and accuracy make these programs the most powerful and user friendly of their kind. (FI)

40288 **(N—87-20767) Hypercluster: a parallel processing test-bed architecture for computational mechanics applications.** Blech, R.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 11p. (NASA-TM—89823; E—3469; NAS—1.15:89823; CONF-870706—1). NTIS, PC A02/MF A01.

From Summer computer simulation conference; Montreal, Canada (27 Jul 1987).

The development of numerical methods and software tools for parallel processors can be aided through the use of a hardware test-bed. The test-bed architecture must be flexible enough to support investigations into architecture-algorithm interactions. One way to implement a test-bed is to use a commercial parallel processor. Unfortunately, most commercial parallel processors are fixed in their interconnection and/or processor architecture. In this paper, we describe a modified n cube architecture, called the hypercluster, which is a superset of many other processor and interconnection architectures. The hypercluster is intended to support research into parallel processing of computational fluid and structural mechanics problems which may require a number of different architectural configurations. An example of how a typical partial differential equation solution algorithm maps on to the hypercluster is given.

40289 **(SAND—87-0022C) Hybrid direct-iterative solution methods in concurrent finite element analysis.** Benner, R.E.; Montry, G.R.; Weigand, G.G. (Sandia National Labs., Albuquerque, NM (USA)). 23 Jun 1987. Contract AC04-76DP00789. 18p. (CONF-870677—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010497.

From 6. IMACS international symposium on computer methods for partial differential equations; Bethlehem, PA, USA (23 Jun 1987).

We have implemented a direct, multifrontal solution method with nested dissection ordering of finite element equations on a ten-processor ELXSI 6400 system (a shared memory architecture with local cache memory at each processor). A limitation of this concurrent direct method is an elimination tree that idles most processors while equations associated with the domain dissections are solved. A potential improvement in concurrent performance can be realized by replacing the elimination tree in the direct method with an embedded, highly concurrent, iterative solution of the dissection equations. Results feature the convergence and concurrent speedup behavior of the new method applied to well-conditioned (Laplace equation) and poorly-conditioned (bending beam) problems in two dimensions.

40290 **(SAND—87-0267) Data acquisition and control programs for Solartron's frequency response analyzer and electrochemical interface on the DEC Micro PDP-11.** Guilinger, T.R.; Melgaard, D.K. (J and M Systems Ltd., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011610.

We developed three programs in FORTRAN to control and acquire data from Solartron's Model 1250 and 1286 Frequency Response Analyzer and Electrochemical Interface. FRA operates the 1250, EI operates the 1286, and FREI operates the 1250 in conjunction with the 1286. The programs are menu-driven and provide some error recovery. Coupled with a commercially available graphics program, data can be plotted as acquired. Some desirable features for electrochemical polarization not available via front panel control on the 1286 are provided by software control in EI and FREI.

40291 **(SAND—87-0584C) Prototyping a dialogue interface: A case study.** Chao, B.P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870841—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008646.

From 2. international conference on human-computer interaction; Honolulu, HI, USA (10 Aug 1987).

Numerous human-computer design guidelines and tools have recently become available to designers to aid the development of high-quality user interfaces. These techniques are needed because of the increasing importance for well-designed, user-friendly computer dialogues. At Sandia, a microcomputer-based prototyping tool is used in the design of interactive military systems. The purpose of this paper is to report the findings of an evaluation conducted on the user interfaces for a weapon command and control system. The findings revealed important user considerations that pertain to information organization and presentation, dialogue modes, and entry devices. By focusing on these specific user considerations, future designs can be greatly facilitated.

40292 **(SAND—87-0649C) Multigroup radiation transport in one-dimensional Lagrangian radiation-hydrodynamics codes.** Rottler, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011062.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A new treatment of radiation transport has been added to the Lagrangian radiation-hydrodynamics code CHARTD. The new energy flow model was derived based on the assumption that the directional dependence of the radiation energy density can be represented by the first two terms of a spherical harmonic expansion, and that the photon energy spectrum can be partitioned into energy groups. The time derivative in the second moment equation, which is usually neglected, is retained in this implementation of the multigroup P-1 approximation. An accelerated iterative scheme is used to solve the difference equations. The new energy flow model and the iterative scheme will be described.

40293 **(SAND—87-0726C) CTH: A three-dimensional, large deformation, shock wave physics code.** McGlaun, J.M.; Zeigler, F.J.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011315.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

CTH is a code system under development at Sandia National Laboratories to model multidimensional, multi-material, large deformation, strong shock physics. One-dimensional, two-dimensional and three-dimensional Eulerian capabilities have been implemented first. Highly accurate analytic and tabular equations of state with solid, liquid, vapor, gas-liquid mixed phase and solid-liquid mixed phase capabilities can be used. The architecture of CTH was designed to accommodate other numerical approaches such as Lagrangian or ALE methods. CTH was carefully structured to run fast on a CRAY XMP. It is highly vectorized and multitasked. We briefly discuss the models used in CTH, techniques used to multitask the code and example calculations.

40294 **(UCRL—52000-87-5) Energy and Technology Review, May 1987.** Lear, R.D.; Crawford, R.B.; de Vore, L.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010851.

The four articles are processed separately for the data base. (DLC)

40295 (UCRL—52000-87-5, pp 1-8) **Shadows for computer graphic realism.** 1987. NTIS, PC A03/MF A01. File Number DE87010851.

In Energy and Technology Review, May 1987.

Algorithms to add realistic shadows to computer graphic images of complex objects are being developed at LLNL. The demands of solid modeling, computer simulation, and computer animation applications for ever greater realism have spurred the development of a variety of techniques to simulate the effects of natural lighting. We have made a series of advances in ways to render realistic shadows cast by bumps on surfaces, by tree leaves on the ground, and by the individual atoms in molecular models, as well as light beams caused by atmospheric scattering from dust and smoke particles. We have also found ways to improve the computation of shadow penumbras, of the effects of sky illumination, and of shadows in perspective renderings.

40296 (UCRL—52000-87-5, pp 9-13) **The SISAL language project.** 1987. NTIS, PC A03/MF A01. File Number DE87010851.

In Energy and Technology Review, May 1987.

We are developing a programming language (SISAL) designed for use on the massively parallel computers expected to emerge in the late 1990s in response to the ever-increasing demand for faster computation. Attempts to adapt existing sequential languages to this task have serious disadvantages; they increase chances for computer error instead of reducing them. The SISAL applicative language we are developing treats parallelism as a normal condition instead of an exotic requirement grafted onto sequential computing. Goal is to use effectively computers designed to calculate a thousand times faster than existing supercomputers.

40297 **(UCRL—96033-Rev.1) A systolic array for efficient matrix-matrix multiplication.** De Groot, A.J.; Johansson, E.M.; Parker, S.R. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 17p. (CONF-870831—2-Rev.1). NTIS MF A01; 2; GPO Dep. File Number DE87007448.

From International conference on parallel processing; St. Charles, IL, USA (17 Aug 1987).

The Systolic Processor with a Reconfigurable Interconnection Network of Transputers (SPRINT) is a sixty-four-processor multiprocessor developed at Lawrence Livermore National Laboratory for experimentally evaluating systolic algorithms and architectures. Its computation capabilities surpass its communication capabilities. Techniques have been developed to perform matrix-matrix multiplication utilizing most of its computing capability by operating on block matrices. These techniques reduce communication bandwidth requirements for a given computation rate. Using these techniques, processor efficiencies can approach 1. Previous techniques resulted in processor efficiency of 1/3. The algorithms are executed on the SPRINT to compare theory with experiment.

40298 **(Y/CM—0071) A study of the computer-integrated manufacturing (CIM) program at the Oak Ridge Y-12 Plant.** Murphy, S.M. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 26 Mar 1987. Contract AC05-84OS21400. 21p. (CONF-8703155—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012330.

From CASA/SME CIMTECH meeting; Los Angeles, CA, USA (27 Mar 1987).

CIM is a dominant force at the Y-12 Plant, winner of the 1986 CASA/SME Industry LEAD Award, as this manufacturing facility migrates to a factory-of-the-future environment. Top Management commitment to CIM was demonstrated by establishing long-term strategic business goals. CIM focus is on four technology zones: information systems, computer network systems, computer-aided design, and computer-aided manufacturing. CIM is both an integrating technology and a management philosophy at Y-12, and plant business systems are being developed to integrate the total business environment. Top-down CIM strategic planning, combined with strong user input, directs the selection of investments. Benefit management techniques are used, and budgets are reduced based on CIM savings. The dynamic nature of CIM is recognized, and program direction is periodically adjusted based on lessons learned.

40299 **(Y/DW—708) Planning the transition to the CIM [computer-integrated manufacturing] environment at the Oak Ridge Y-12 Plant.** Bowers, G.L.; Murphy, S.M. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 24 Mar 1987. Contract AC05-84OS21400. 16p. (CONF-8704176—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012327.

From CASA/SME seminar; Chicago, IL, USA (28 Apr 1987).

Formalized efforts have been ongoing within the Oak Ridge Y-12 Plant since 1982 to plan and implement a computer-integrated manufacturing (CIM) environment. This presentation addresses activities past and present that are enabling the Y-12 facility to make the transition into the CIM environment. Specific issues addressed are: (1) present and future modeling for manufacturing process, business model, data architecture, and information systems architecture; (2) establishing a formal CIM organization to be responsible for CIM planning and implementation; (3) establishing specific Plant performance goals relating to CIM objectives; (4) conducting CIM needs analysis with the production organizations to foster a basic understanding of the CIM concept and to identify CIM opportunities; and (5) CIM Program status.

40300 **Construction of preconditioners for elliptic problems by substructuring. II.** Bramble, J.H.; Pasciak, J.E.; Schatz, A.H. ((Peking University)). *Mathematics of Computation;* **49**: No. 179, 1-16(Jul 1987).

We give a method for constructing preconditioners for the discrete systems arising in the approximation of solutions of elliptic boundary value problems. These preconditioners are based on domain decomposition techniques and lead to algorithms which are well suited for parallel computing environments. The method presented in this paper leads to a preconditioned system with condition number proportional to d/h where d is the subdomain size and h is the mesh size. These techniques are applied to singularly perturbed problems and problems in the three dimensions. The results of numerical experiments illustrating the performance of the method on problems in two and three dimensions are given.

40301 **Some plane curvature approximations.** Mjolsness, R.C.; Swartz, B. ((Peking University)). *Mathematics of Computation;* **49**: No. 179, 215-230(Jul 1987).

Second-order accurate approximations to the curvature function along a sufficiently smooth plane curve are presented, the curve being given in finite form (and thus, approximately) by N+2

points taken along its full length. The curvature estimates are continuous and invariant under translation and rotation, and they are based on local information: so are easy to implement computationally. In particular, second-order accurate estimates of surface tension forces halfway between immediate neighbors in the curve's mesh can thereby be made for hydrodynamic simulations.

40302 **An adaptive general sparse out-of-core Cholesky factorization scheme.** Liu, J.W.H. (Dept. of Computer Science, York Univ., Downsview, Ontario, M3J 1P3). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 4, 585-599(Jul 1987).

A practical out-of-core Cholesky factorization scheme is introduced that is based on reorganizations of the matrix data structure during the factorization. It is applicable to the factorization of both dense and sparse matrices. The scheme can be regarded as a simple extension of the conventional in-core sparse factorization method. It is highly adaptive in the sense that it will run successfully in a range of storage sizes. Experimental results on some large sparse practical problems are provided; they show significant reduction in storage requirement for Cholesky factors with little increase (and sometimes decrease) in execution time.

40303 **A continuation approach for solving large-residual nonlinear least squares problems.** Salane, D.E. (Numerical Mathematics Div., Sandia National Labs., Albuquerque, NM). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 4, 655-671(Jul 1987). Contract AC04-76DP00789.

This paper is concerned with the solution of the nonlinear least squares problem. A continuation method is used to develop a new framework for the model trust region approach for solving nonlinear least squares problems. This framework gives a motivation for the direct selection of the trust region parameter. It also provides a natural safeguard for trust region methods and leads to a very robust algorithm. A class of algorithms based on the continuation method is presented. In addition, the implementation details for one member of the new class are examined. The convergence and descent properties of this algorithm are discussed. Numerical evidence are given showing that the new algorithms are competitive with existing model trust region algorithms. For large-residual problems or problems in which a good initial starting guess is not available, the performance of the new algorithm is very promising.

40304 **Numerical analysis and the scientific method.** Glimm, J.; Sharp, D.H. (Courant Institute of Mathematical Sciences, New York Univ., 251 Mercer Street, New York, NY 10012). *IBM Journal of Research and Development;* **31**: No. 2, 169-177(Mar 1987).

The computer has given rise to a new mode of scientific practice, and today computational science stands beside theory and experiment as a fundamental methodology. The impact of the computer revolution on science can be projected from current trends. The demands to be made on computing methodologies are reviewed. One of the demands is an ongoing need for excellence in computational methodologies. Generic difficulties encountered in meeting these challenges are discussed. Recent work of the authors and others is reviewed in this context. Supercomputers can explore a much wider range of ideas than can be actually tested.

40305 **Formal verification of properties of digital systems using an automated reasoning system.** Kljaich, J.; Wojcik, A.S.; Smith, B.T. (Mathematics and Computer Science Div., Argonne National Lab., Argonne, IL 60439). pp 486-491 of Proceedings of the sixth annual international Phoenix conference on computers and communications. Friesen, O.; Golshani, F. Piscataway, NJ; IEEE Service Center (1987). (CONF-870208—).

From 6. annual IEEE Phoenix conference on computers and communications; Scottsdale, AZ, USA (25 Feb 1987).

With the increasing interest in applying artificial intelligence techniques to problems in design automation, attention has been directed to developing additional approaches to the verification of properties of digital systems. Properties of interest would include functionality, timing behavior, and fault-tolerance capabilities. This paper describes a part of an ongoing research project whose goal is to develop a formal design verification system based on the use of ITP, and LMA (Logical Machine Architecture) based Interactive Theorem Prover developed at Argonne National Laboratory. Specifically, a Petri net representation for systems is described together with the ITP implementation of a rule-based system for the manipulation of system descriptions. To illustrate the representation and the capabilities of the system under development, the Draper Laboratories Fault-Tolerant Processor is used as an example. Results concerning the formal verification of the fault-tolerant properties of this system are described.

40306 **Performance of various computers using standard linear equations software in a Fortran environment.** Dongarra, J.J. (Mathematics and Computer Science Div., Argonne National Lab., Argonne, IL 60439). pp 15-34 of Multiprocessors and array processors. Karplus, W.J. Littleton, CO; Society of Mining Engineers of AIME (1987). (CONF-870129—).

From Society of Computer Simulation multiconference; San Diego, CA, USA (14 Jan 1987).

This note compares the performance of different computer systems while solving dense systems of linear equations using the LINPACK software in a Fortran environment. About 100 computers, ranging from a CRAY X-MP to the 68000 based systems such as the Apollo and SUN Workstations to IBM PC's, are compared.

40307 **On the implementation of a fully parallel algorithm for the symmetric eigenvalue problem.** Dongarra, J.J.; Sorensen, D.C. (Argonne National Lab., Argonne, IL). pp 45-53 of Advanced algorithms and architectures for signal processing. Speiser, J.M. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract AC05-84OR21400;FG02-85ER25001;W-31-109-ENG-38.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

In this paper the authors present a parallel algorithm for the symmetric algebraic eigenvalue problem. The algorithm is based upon a divide and conquer scheme suggested by Cuppen for computing the eigensystem of a symmetric tridiagonal matrix. The authors extend this idea to obtain a parallel algorithm that retains a number of active parallel processes that is greater than or equal to the initial number throughout the course of the computation. Computation of the eigensystem of the tridiagonal matrix is reviewed. Also, brief analysis of the numerical properties and sensitivity to round off error is presented to indicate where numerical difficulties may occur. The authors show how to explicitly overlap the initial reduction to tridiagonal form with the parallel computation of the eigensystem of the tridiagonal matrix. The algorithm is therefore able to exploit parallelism at all levels of the computation and is well suited to a variety of architectures. Computational results have been presented for several machines. These results are very encouraging with respect to both accuracy and speedup. A surprising result is that the parallel algorithm for the tridiagonal case, even when run in serial mode, can be significantly faster than the previously best sequential algorithm on large problems, and is effective on moderate size problems when run in serial mode.

40308 **A virtual-time operating-system shell for a hypercube in robotics applications.** Einstein, J.R.; Barhen, J.; Jefferson, D. (Center for Engineering Systems Advanced Research, Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831-6364). pp 424-430 of Intelligent robots and computer vision. Casasent, D.P. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8610215—). Contract AC05-84OR21400.

From SPIE's Cambridge symposium on optical and optoelectronic engineering: advanced in intelligent robotics systems; Cambridge, MA, USA (26 Oct 1986).

Hypercube multiprocessors possess many attributes advantageous for autonomus, intelligent robots which operate in time-critical fashion in hostile environments. However, their message-passing architecture presents certain difficulties in rapid changes of plans in response to unpredictable events in the environment. The status of a "virtual-time" operating-system shell, providing functions which facilitate such responses, is described.

40309 **The t-expansion: Status report.** Karliner, M.; Weinstein, M. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 119-134 of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

The status of the t-expansion is reviewed. Some prospects of applying the expansion for hadron spectrum computation are also discussed.

9903 Information Handling

REFER ALSO TO CITATION(S) 38804, 39289, 39561

40310 **(BNL-NCS—39756) NNDC [National Nuclear Data Center] on-line services documentation.** Dunford, C.L.; Burrows, T.W.; Tuli, J.K. (Brookhaven National Lab., Upton, NY (USA)). 31 Mar 1987. Contract AC02-76CH00016. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011288.

This document summarizes and describes how to access the on-line services available from the National Nuclear Data Center (NNDC) located at Brookhaven National Laboratory. The services are available free of cost to US Department of Energy, its contractors and others who support the NNDC or supply data to the NNDC. Four of the center's data bases are now accessible to non-NNDC scientists via remote connection to the center's VAX 11/780. To use this service, you must have a terminal with access by either a telephone line or the PHYSNET network. A VT100 terminal or a terminal with VT-100 emulation is recommended but not required.

40311 **(CONF-8705111—2) Computer-aided research.** Hartley, D.S. III. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010016.

From TIMS/ORSA joint national meeting; New Orleans, LA, USA (4 May 1987).

A computer system can be an invaluable aid to the author of a professional article by helping him to gather, maintain and use reference notes made during the literature-search phase. The researcher/author can build his own set of cross references "as he goes" and then retrieve those he later determines to be most relevant to this topic. As the data-base continues to grow, the system's usefulness increases.

40312 **(DOE/DP/70033—1) Research and development of models and instruments to define, measure, and improve shared information processing within government oversight agencies: Annual performance report, August 1986-February 1987.** Kurstedt, H.A. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Management Systems Labs.). 1987. Contract FG05-86DP70033. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012473.

The tangible result of the research effort will be an integrated set of descriptive, prescriptive, predicative, performance, and responsive tools that will collectively allow GOA's to increase their performance to the highest levels possible. GOA's will see increases in productivity, fewer conflicts between headquarters and the field, greater motivation on the part of personnel who actively share in the process of decision making, and greater credibility with Congress, the public, and the media. This results from the consistency and integrity of data and information - and the correct perception of government running a tight ship.

40313 **(DOE/TIC—3407) Savannah River Scientific and Technical Documents, 1975-1986: A bibliography.** Raleigh, H.D. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Aug 1987. 563p. (DP—929-A1). NTIS, PC A24/MF A01; 4; GPO Dep. File Number DE87007069.

This bibliography contains information on all scientific and technical documents prepared by the E.I. duPont de Nemours and Co. sponsored by the Department of Energy and released to the general public during the period 1975 through 1986. The abstracts are grouped by subject category and each category arrangement is in reverse chronological order. Entries in the subject index also facilitate access by subject, e.g., waste, environment, reactor, etc. The production facilities at Savannah River provide support for the requirements of national defense. Research and development activities cover a wide range of subjects from the basic sciences to applied technology. A significant percentage of the research reports concern waste management, radiochemical procedures, and environmental studies.

40314 **(INIS-BR—617) SONAR: a multibase and parametric interface software for SDI.** Fonseca Passos, M.C.J. da. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. 12p. (In Portuguese). (CONF-8610277—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702454.

From 2. national meeting on librarianship and informatics; 2. national meeting on legal information and documentation; Brasilia, Brazil (26 Oct 1986).

SONAR - an automated service for selective dissemination of information (SDI) - developed by the Centro de Informacoes Nucleares (CIN) of the Comissao Nacional de Energia Nuclear (CNEN) is described. Emphasis is given to the multibase feature of the system based on the parametric interface between the system and an external data base reading subroutine.

40315 **(INIS-BR—618) SERVIR: an automated document delivery system.** Lima, E.C.; Azevedo Coutinho, O.C. de. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. 12p. (In Portuguese). (CONF-8610277—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702455.

From 2. national meeting on librarianship and informatics; 2. national meeting on legal information and documentation; Brasilia, Brazil (26 Oct 1986).

SERVIR, an automated document delivery system developed by CIN/CNEN, is described. Parametric procedures for reading bibliographic data bases and requesting documents from libraries through computers are specified. Statistical procedures, accounting system and the on-line fulfillment of requests are presented.

40316 **(KFK—4179) JOYFOR: A program for transformation of NJOY results in MATXS-format to the MITRA input format.** Krieg, B.; Broeders, I. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Feb 1987. 33p. NTIS, PC E07; Available from NTIS as TIB/B87-06404.

The program JOYFOR is the connection between the output of the group constant calculation code NJOY in MATXS-format and the testing and formatting program MITRA. Resonance self-shielding factors as well as transfer matrices for elastic and inelastic scattering and for (n,2n)- and (n,3n)-processes, normalized corresponding to the conventions of MITRA, are calculated by JOYFOR from the NJOY results and are written in MIGROS-format on an external file and on the standard output unit. Also the group cross-sections for infinite dilution, the 1/v-values and the fission spectrum are written out in the same format as in MIGROS. KERMA-factors are handled by JOYFOR in the same way as group cross-sections. The output data of JOYFOR may be tested by MITRA and transformed into input for the GRUBA management program GRUMA. The present version of JOYFOR handles group constants for neutron reactions only. Extension of the program to photon reactions is being planned.

40317 **(LBL—19149) Bit transposed files.** Wong, H.K.T.; Liu, F.; Olken, F.; Rotem, D.; Wong, L. (Lawrence Berkeley Lab., CA (USA)). Feb 1985. Contract AC03-76SF00098. 24p. (CONF-8509399—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010984.

From Very large data bases conference; Stockholm, Sweden (26 Sep 1985).

This paper first examines the reasons why sophisticated access methods are often not used in large Scientific/Statistical Database (SSDB) applications. A file structure (called bit transposed

file) is proposed which offers several attractive features that are better suited for the special characteristics that SSDBs exhibit. This file structure is an extreme version of the transposed file where the data is stored by vertical bitwise partitions (rather than by attributewise). The bit patterns of attributes are assigned using one of several index encoding methods. Each of these encoding methods is appropriate for different query types and access requirements. The bit partitions can also be compressed using a version of the run length encoding scheme. Efficient operators on compressed bit vectors are available to form the backbone of a query language. In addition to selective power with low overhead for SSDBs, the bit transposed file also is amenable to special parallel hardware. Results from experiments with the file structure suggest that this may be a reasonable alternative file structure for large SSDBs.

40318 **(LBL—22636) Logical modeling of temporal data.** Segev, A.; Shoshani, A. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 16p. (CONF-8705107—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011221.

From SIGMOD '87 conference; San Francisco, CA, USA (27 May 1987).

Semantics are examined and constructs are developed for temporal data independent of any traditional data model, such as the relational or network data models. Unlike many other works which extend existing models to support temporal data, the purpose is to characterize the properties of temporal data and operators over them without being influenced by traditional models which were not specifically designed to model temporal data. Data constructs are developed that represent sequences of temporal values, identify their semantic properties, and define operations over these structures.

9904 Law

40319 **(INIS-mf—10915) Post-Chernobyl emergency planning.** (Board of Accident Investigations, Stockholm (Sweden)). 1986. 400p. (In Swedish). NTIS (US Sales Only), PC A17/MF A01. File Number DE87751946.

This report is the result of a study ordered by the Swedish Nuclear Power Inspectorate and the National Swedish Institute of Radiation Protection to evaluate the measurements taken in Sweden in response to the Chernobyl accident. The enquiry was also given the task of suggesting improvements of the nuclear accidents emergency planning and other activities relevant to nuclear accidents. Detailed accounts are given of the course of events in Sweden at the Chernobyl accident and the steps taken by central or local authorities are discussed. Several alterations of the emergency planning are proposed and a better coordination of the affected organizations is suggested. (L.E.).

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Aaf, Energikonsult, Stockholm (Sweden)
Industry's use of electric power. After Chernobyl, 12:38794 (R;SE;In Swedish)
New production of electric power when accelerating nuclear power phaseout. After Chernobyl, 12:38796 (R;SE;In Swedish)

ACTION-Housing, Inc., Pittsburgh, PA (USA)
MCCAA [Mercer County Community Action Agency] residential ESCO [Energy Service Company] market study, 12:39056 (R;US)

Acurex Corp., Mountain View, CA (USA)
Ceramic-fiber ceramic-matrix hot-gas filters, 12:38797 (R;US)

Advanced Fuel Research, Inc., East Hartford, CT (USA)
Expansion of high-temperature high-pressure data set for coal gasification: Quarterly report, September-December 1986, 12:38432 (R;US)

Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)
Advanced instrumentation for aero engine components, 12:39528 (R;FR;In several languages)

Aerodyne Research, Inc., Billerica, MA (USA). Center for Chemical and Environmental Physics
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Qualifier
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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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	Brookhaven National Lab., Upton, NY (USA)	
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AC02-76ER01195	**Stanford Linear Accelerator Center, Menlo Park, CA (USA)**	
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AC02-76ER01198	**Department of Materials Science and Engineering and Materials Research Laboratory, University of Ill**	
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AC02-77CH00178	**Solar Energy Research Institute, Golden, Colorado 80401**	
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AC02-78ET51013	**Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center**	
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	12:40180	DOE/ET/51013—217
AC02-80ER10719	**State Univ. of New York, Stony Brook (USA)**	
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AC02-82CE40539	**Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.**	
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AC02-82ER60076	**Cincinnati Univ., OH (USA). Dept. of Environmental Health**	
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AC02-83CH10093	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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	Chem Systems, Inc., Tarrytown, NY (USA)	
	12:38702	SERI/STR—231-3135
	Georgia Inst. of Tech., Atlanta (USA)	
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	Stone and Webster Engineering Corp., Boston, MA (USA)	
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	Solar Energy Research Inst., Golden, CO (USA)	
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AC02-83ER60163	**Pennsylvania Univ., Philadelphia (USA). Dept. of Radiation Therapy**	
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AC03-76SF00098	**Lawrence Berkeley Lab., CA (USA)**	
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AC03-76SF00515	**Stanford Linear Accelerator Center, Menlo Park, CA (USA)**	
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	12:39503	SLAC-PUB—4303
	12:39517	SLAC-PUB—4297
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	12:39949	SLAC-PUB—4270
AC03-84ER51044	**GA Technologies, Inc., San Diego, CA (USA)**	
	12:40182	GA-A—18173
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AC04-76DP00613	**Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.**	
	12:39437	BDX—613-3700
AC04-76DP00789	**Sandia National Labs., Organization 6254, Albuquerque, NM 87185**	
	12:38457	Industrial and Engineering Chemistry Research 26 NO. 4. 840-845 (Apr 1987).
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	Bechtel National, Inc., San Francisco, CA (USA)	
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	RE/SPEC, Inc., Rapid City, SD (USA)	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	Jet Propulsion Lab., Pasadena, CA (USA)	
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	12:40247	Journal of Nuclear Materials 141-143 NO. B. 727-730 (Nov-Dec 1986).
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	Sandia National Labs., Albuquerque, NM (USA)	
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AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
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AC04-78AL10752	**New Mexico Health and Environment Dept., Santa Fe (USA). Environmental Evaluation Group**	
	12:38614	DOE/AL/10752—36
AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
	12:38844	DOE/OR/00033—T250
	12:39010	DOE/ER—0323
	12:39011	DOE/ER—0324
	Committee on Interagency Radiation Research and Policy Coordination, Washington, DC (USA)	
	12:40100	DOE/OR/00033—T323
AC05-84ER40150	**Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)**	
	12:39900	DOE/ER/40150—31
	12:40051	DOE/ER/40150—17
AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
	12:38427	CONF-870773—1
	12:38429	CONF-8705103—3
	12:38475	Preprints of Papers, American Chemical Society, Division of Fuel Chemistry 32 NO. 1. 337-3
	H and R Technical Associates, Inc., Oak Ridge, TN (USA)	
	12:38577	ORNL/Sub—87-38435C/1&28
	Oak Ridge National Lab., TN (USA)	
	12:38613	CONF-870822—2
	12:38797	CONF-870659—3
	12:38841	CONF-870102—6
	12:38878	DOE/OR/21400—T300
	12:38888	ORNL/TM—10349
	12:38889	ORNL/TM—10350
	Franklin Research Center, Philadelphia, PA (USA)	
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	Oak Ridge National Lab., TN (USA)	
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	Institute of Gas Technology, Chicago, IL (USA)	
	12:39107	ORNL/Sub—84-47989/2
	Oak Ridge National Lab., TN (USA)	
	12:39185	CONF-870719—1
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	12:39187	CONF-870733—5
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AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (USA)**	
	12:39269	Y/DV—605/R2
	12:40298	Y/CM—0071
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AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
	12:38566	K/OA—6076
	12:38672	K/ITP—103
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	12:39262	K/ETAC—22
AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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	Quintus Computer Systems, Palo Alto, CA (USA)	
	12:38918	HEDL-SA—3511-FP
	Hanford Engineering Development Lab., Richland, WA (USA)	
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AC06-76RL01830	**Idaho Univ., Moscow (USA). Dept. of Chemical Engineering**	
	12:38647	PNL-SA—14508
	Pacific Northwest Lab., Richland, WA (USA)	
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	12:38751	PNL-SA—14030
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	12:39015	PNL-SA—14640
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	12:39686	PNL-SA—14684
	12:39727	PNL-SA—14861
AC06-76RL01857	UNC Nuclear Industries, Inc., Richland, WA (USA)	
	12:38659	UNI-SA—172-Rev.1
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AC06-81ER40048	Washington Univ., Seattle (USA). Dept. of Physics	
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AC07-76ID01570	EG and G Idaho, Inc., Idaho Falls (USA)	
	12:38571	EGG-ME—7679
	12:38604	CONF-860990—Pt.1
	12:38605	CONF-860990—Pt.2
	12:38606	CONF-860990—Pt.3
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	12:38608	CONF-860990—Pt.5
	12:38609	CONF-860990—Pt.6
	12:38610	CONF-860990—Pt.7
	12:38611	CONF-860990—Pt.8
	12:38612	CONF-860990—Summ.
	12:38620	EGG-WM—7636
	12:38621	EGG-WM—7637
	12:38622	EGG-WT—7610
	12:38865	EGG-M—34386
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	12:39261	EGG-M—35686
AC07-79ET27014	Washington State Dept. of Natural Resources, Olympia (USA). Div. of Geology and Earth Resources	
	12:39719	DOE/ET/27014—2
	12:39720	DOE/ET/27014—3
AC07-86ID12650	Babcock and Wilcox Co., Lynchburg, VA (USA)	
	12:38617	DOE/ID/12650—1
AC08-82DP40152	KMS Fusion, Inc., Ann Arbor, MI (USA)	
	12:40176	DOE/DP/40152—17
AC08-83NV10282	EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations	
	12:39624	EGG—10282-2154
AC08-85NV10384	Nevada Univ., Reno (USA). Water Resources Center	
	12:39636	DOE/NV/10384—03
AC09-76SR00001	Savannah River Lab., Aiken, SC (USA)	
	12:38570	DP-MS—87-12
	Main (Charles T.), Inc., Charlotte, NC (USA)	
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	Savannah River Lab., Aiken, SC (USA)	
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
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	12:39225	DPST—86-743
	Savannah River Lab., Aiken, SC (USA)	
	12:39440	DPST—87-437
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
	12:39617	DPSPU—87-30-1-Vol.1
	12:39637	DPSPU—87-30-1-Vol.2
AC09-76SR00819	Savannah River Ecology Lab., Aiken, SC (USA)	
	12:39646	SRO—819-17
AC21-83MC20320	West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering	
	12:38431	DOE/MC/20320—2355
AC21-84MC21004	Advanced Fuel Research, Inc., East Hartford, CT (USA)	
	12:38432	DOE/MC/21004—2285
AC21-84MC21046	Radian Corp., Austin, TX (USA)	
	12:38433	DOE/MC/21046—2329
AC21-84MC21179	New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center	
	12:38540	DOE/MC/21179—2272
AC21-84MC21181	Geoexplorers International, Inc., Denver, CO (USA)	
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AC21-84MC21225	Institute of Gas Technology, Chicago, IL (USA)	
	12:38434	DOE/MC/21225—2267
AC21-84MC21387	Pittsburgh Univ., PA (USA). School of Engineering	
	12:38498	DOE/MC/21387—2359
AC21-85MC22123	General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div.	
	12:39119	DOE/MC/22123—2281
AC21-86MC23057	Institute of Gas Technology, Chicago, IL (USA)	
	12:38436	DOE/MC/23057—2273
AC21-86MC23167	Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Operations	
	12:38785	DOE/MC/23167—2277
AC21-86MC23265	IIT Research Inst., Chicago, IL (USA)	
	12:39048	DOE/MC/23265—2362
AC22-85PC81008	Tennessee Univ., Tullahoma (USA). Space Inst.	
	12:38798	DOE/PC/81008—T8
AC79-84BP16112	Carroll, Hatch and Associates, Inc., Portland, OR (USA)	
	12:39125	DOE/BP/16112—T2
AC79-84BP18946	URS/TransEnergy Systems, Seattle, WA (USA)	
	12:39126	DOE/BP/18946—T3
	12:39127	DOE/BP/18946—T4
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AI07-80ID12138	Jet Propulsion Lab., Pasadena, CA (USA)	
	12:39190	DOE/ID/12138—6
AI09-78SR01052	Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station	
	12:38720	DOE/SR/01052—9
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AI09-80SR10702	Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station	
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AI09-80SR10711	Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station	
	12:39610	DOE/SR/10711—6
AI79-84BP14903	Idaho Dept. of Fish and Game, Lewiston (USA)	
	12:39643	DOE/BP/14903—1
AS05-79ER10348	Tennessee Univ., Knoxville (USA)	
	12:39259	DOE/ER/10348—9
FC07-82CS40419	Construction Technology Labs., Skokie, IL (USA)	
	12:39132	DOE/CS/40419—T1
FC21-83FE60181	Univ. of North Dakota, Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202	
	12:38469	Preprints of Papers, American Chemical Society, Division of Fuel Chemistry 32 NO. 1. 70-81
FC21-85MC22146	Allis-Chalmers Coal Gas Corp., Milwaukee, WI (USA)	
	12:38435	DOE/MC/22146—2309
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	12:39319	NIPER—247
FG01-86CE15279	AV-YO, Inc., Kaneohe, HI (USA)	
	12:38778	DOE/CE/15279—T4
FG01-86CE63476	Pacific Asian Consortium in Employment, Los Angeles, CA (USA)	
	12:39055	DOE/CE/63476—T1
FG01-86CE63477	ACTION-Housing, Inc., Pittsburgh, PA (USA)	
	12:39056	DOE/CE/63477—T5

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FG01-86CE63496	**Syracuse Energy Service Co., Inc., NY (USA)**	
	12:39057	DOE/CE/63496—T1
FG02-84ER13269	**Aerodyne Research, Inc., Billerica, MA (USA). Center for Chemical and Environmental Physics**	
	12:39342	DOE/ER/13269—T2
FG02-84ER45077	**Pennsylvania State Univ., University Park (USA). Materials Research Lab.**	
	12:39260	DOE/ER/45077—2
FG02-85ER13315	**Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science**	
	12:39354	DOE/ER/13315—2
FG02-85ER13449	**Tokyo Univ. (Japan). Meson Science Lab.**	
	12:39881	DOE/ER/13449—T11
FG02-85ER60297	**Colorado State Univ., Fort Collins (USA). Dept. of Fishery and Wildlife Biology**	
	12:39606	DOE/ER/60297—4
FG02-85ER60372	**Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory**	
	12:39575	DOE/ER/60372—2
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39865	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011302	MN -11	12:39561
39898	NTIS, PC A02; 3	DE87011292	MN -25	12:39255
39942	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012125	MN -4	12:39316
39981	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012491	MN -34C	12:40033
39984	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012490	MN -15	12:38669
39992	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012478	MN -13	12:40278
40004	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012488	MN -25	12:39182
40038	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012870	MN -4	12:39289
52033	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007040	STD -80	12:38900
52067	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012306	STD -97a	12:39351
52074	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012305	MN -70B	12:38603
BNL-NCS-				
39756	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011288	MN -32	12:40310
BNL-NUREG-				
39222	NTIS, PC A03/MF A01 - GPO	TI87005862	MN -78	12:38901
39597	NTIS, PC A02/MF A01; 1	DE87008717	MN -80	12:38863
39637	NTIS, PC A02; 3	DE87009142	MN -78	12:38902
39762	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010462	MN -78	12:38864
39850	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010756	MN -80	12:38903
51454-Vol.6-No.2	*See* NUREG/CR-2331-Vol.6-No.2	TI87005050	MN -80	12:38975
BONN-HE-				
86-36	NTIS PC E07; Available from NTIS as TIB/B87-06416		ND -34D	12:39935
CEA-CONF-				
8849	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752195	MN -25	12:39183
8914	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752642	MN -25	12:39184
CEBAF-PR-				
86-011	*See* DOE/ER/40150-17	E 1.99: DE87008665	MN -34C	12:40051
CEBAF-R-				
86-013	*See* DOE/ER/40150-31	E 1.99: DE87012468	MN -34C	12:39900
CERL-TR-E-				
87/ 02	*See* AD-A-179821/4/XAB			12:39050
CNA-PP-				
453	*See* AD-A-180003/6/XAB			12:39175
CNEN-DR-				
133	NTIS (US Sales Only), PC A06/MF A01	DE87702429	MN -34B	12:38881
CNEN-DR-GTT-				
06/ 85	NTIS (US Sales Only), PC A03/MF A01	DE87702430	MN -78	12:38815
07/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87702431	MN -78	12:38816
CONF-800386-	(Annual meeting on nuclear technology, Berlin, F.R. Germany, 25-27 Mar 1980)			
Pt.2	*See* INIS-mf-10624	DE87752240	MN -80	12:38939
Pt.3	*See* INIS-mf-10622	DE87752243	MN -80	12:38836
Pt.4	*See* INIS-mf-10623	DE87752244	MN -80	12:38933
CONF-810326-	(Annual meeting on nuclear technology (Jahrestagung Kerntechnik), Dusseldorf, F.R. Germany, 24-26 Mar 1981)			
Pt.1	*See* INIS-mf-10621	DE87752242	MN -80	12:38927
CONF-8205205-	(Meeting on nuclear technology, Mannheim, F.R. Germany, 4-6 May 1982)			
Pt.2	*See* INIS-mf-10620	DE87752241	MN -80	12:38922

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CONF-8206116-	(DPF summer study on elementary particle physics and future facilities (APS), Aspen, CO, USA, 28 Jun-16 Jul 1982)			
	National Science Foundation, 1800 G Street NW, Washington, DC 20550			12:39932
CONF-8402177-	(Workshop on the production and acceleration of the polarized heavy ion beams and their applications to nuclear physics, Ibaraki, Japan, 3-4 Feb 1984)			
	See RCNP-P-68	DE87702540	MN -28	12:39500
CONF-8406357-	(Meeting on current puzzles in nuclear physics, Ibaraki, Japan, 27-28 Jun 1984)			
	See RCNP-P-73	DE87702544	MN -34C	12:40090
CONF-8406358-	(Workshop on nuclear reaction and cluster structure, Ibaraki, Japan, 25-27 Jun 1984)			
	See RCNP-P-78	DE87702548	MN -34C	12:40091
CONF-8412122-	(Workshop on nuclear piping constructibility, Charlotte, NC, USA, 12-14 Dec 1984)			
	See EPRI-NP-4843-S	TI87920176	ND -80	12:38866
CONF-8412129-	(Workshop on the next plan for the study of physics of fast neutron reactions and measurements, Ibaraki, Japan, 25 Dec 1984)			
	See RCNP-P-74	DE87702545	MN -34C	12:40001
CONF-8412130-	(Workshop on nuclear polarization phenomena, Ibaraki, Japan, 20-22 Dec 1984)			
	See RCNP-P-75	DE87702546	MN -34C	12:40002
CONF-8503282-	(Absorption heat pumps congress, Paris, France, 20-22 Mar 1985)			
	See EUR-10007	DE87780132	MN -95d	12:39102
CONF-8504264-	(Interregional training course on exploration drilling and ore reserve estimation for uranium deposits, Pocos de Caldas, Brazil, 22 Apr-16 May 1985)			
6	*See* INIS-BR-612	DE87702450	MN -51	12:38553
7	*See* INIS-BR-613	DE87702451	MN -51	12:38554
CONF-8504307-	(Symposia on radionuclide-labeled monoclonal antibodies: techniques and applications; and chemical aspects of the production and use of therapeutic nuclides, Miami Beach, FL, USA, 29 Apr-2 May 1985)			
	Nucl. Med. Biol., 13: No. 4, 483-495(1986)			12:39339
	Nucl. Med. Biol., 13: No. 4, 401-405(1986)			12:39666
	Nucl. Med. Biol., 13: No. 4, 407-411(1986)			12:39667
	Nucl. Med. Biol., 13: No. 4, 429-436(1986)			12:39668
	Nucl. Med. Biol., 13: No. 4, 453-456(1986)			12:39669
CONF-8504308-	(Coronal and prominence plasmas conference, Greenbelt, MD, USA, 9 Apr 1985)			
	See N-87-20871			12:39751
CONF-8505122-	(EPES '85 - energy, power and environmental systems international conference, Santa Barbara, CA, USA, 29-31 May 1985)			
4	NTIS, PC A02; 3	DE87011428	MN -105	12:39572
CONF-8505359-	(1. symposium on underground physics, Saint-Vencent, Italy, 25-28 May 1985)			
	Nuovo Cimento Soc. Ital. Fis., C, 9: No. 2, 293-307(Mar-Apr 1986)			12:39868
	Nuovo Cimento Soc. Ital. Fis., C, 9: No. 2, 443-450(Mar-Apr 1986)			12:39869
CONF-8506237-	(Photovoltaics and insolation measurements workshop, Vail, CO, USA, 30 Jun-3 Jul 1985)			
	Sol. Cells, 18: No. 3/4, 179-187(Sep-Oct 1986)			12:38735
	Sol. Cells, 18: No. 3/4, 205-212(Sep-Oct 1986)			12:38736
	Sol. Cells, 18: No. 3/4, 223-232(Sep-Oct 1986)			12:38737
	Sol. Cells, 18: No. 3/4, 233-241(Sep-Oct 1986)			12:38738
	Sol. Cells, 18: No. 3/4, 269-279(Sep-Oct 1986)			12:38739
	Sol. Cells, 18: No. 3/4, 281-288(Sep-Oct 1986)			12:38740
	Sol. Cells, 18: No. 3/4, 363-371(Sep-Oct 1986)			12:38741
	Sol. Cells, 18: No. 3/4, 383-392(Sep-Oct 1986)			12:38742
	Sol. Cells, 18: No. 3/4, 393-395(Sep-Oct 1986)			12:38743
CONF-8506355-	(Scanheating: international conference on process control and energy savings in reheating furnaces, Lulea, Sweden, 12-14 Jun 1985)			
	NTIS (US Sales Only), PC A23/MF A01; 1	DE87752390	MN -95f	12:39124
CONF-850809-	(8. international conference on structural mechanics in reactor technology, Brussels, Belgium, 19-23 Aug 1985)			
87	*See* HEDL-SA-3304-FP	E 1.99: DE87004090	MN -80	12:38868
CONF-850810-	(23. national heat transfer conference, Denver, CO, USA, 4-7 Aug 1985)			
	Nucl. Eng. Des., 101: No. 2, 149-166(May 1987)			12:39434
CONF-850934-	(NUCLEAR INTER JURA meeting, Constance, F.R. Germany, 30 Sep-2 Oct 1985)			
1	*See* INIS-BR-620	DE87702457	MN -2	12:38681
CONF-850982-	(2. annual Pittsburgh coal conference, Pittsburgh, PA, USA, 16-20 Sep 1985)			
4	NTIS, PC A02; 3	DE87011814	MN -102	12:38419
5	NTIS, PC A02; 3	DE87011807	MN -102	12:38420

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CONF-850997-	(International symposium on mining technology and science, Xuzhou, China, 18-20 Sep 1985)			
2	NTIS, PC A02; 3	DE87011810	MN -102	12:38421
CONF-8509399-	(Very large data bases conference, Stockholm, Sweden, 26-29 Sep 1985)			
1	*See* LBL-19149	E 1.99: DE87010984	MN -32	12:40317
CONF-8509404-	(NASA-Chinese aeronautical establishment (CAE) symposium, Cleveland, OH, USA, 23-27 Sep 1985)			
	See N-87-20267			12:39463
CONF-8510160-	(ASM metals congress/TMS-AIME fall meeting, Toronto, Ontario, Canada, 13-18 Oct 1985)			
	Metals Park, OH; American Society for Metals (1987).			12:39219
CONF-851102-	(11. symposium on engineering problems in fusion research, Austin, TX, USA, 18-22 Nov 1985)			
118	*See* GA-A-18173	DE87010910	MN -20a	12:40182
CONF-851123-	(American Institute of Chemical Engineers annual winter meeting, Chicago, IL, USA, 10-14 Nov 1985)			
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38426
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38490
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38535
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38548
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38551
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38552
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:38803
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:39330
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:39331
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:39332
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:39475
CONF-8511286-	(7. Brazilian meeting on nuclear medicine, Rio de Janeiro, RJ, Brazil, 7-9 Nov 1985)			
	See INIS-BR-651	DE87702483	MN -48	12:39653
CONF-8512124-	(Workshop on colibration technique for radiation measurements in vacuum ultraviolet - soft X-ray region, Nagoya, Japan, 19-20 Dec 1985)			
	See IPPJ-DT-127	DE87702506	MN -20	12:40156
CONF-8512125-	(Workshop on emissions from heavy current carrying high density plasma and their diagnostics, Nagoya, Japan, 2-3 Dec 1985)			
	See IPPJ-DT-128	DE87702507	MN -20	12:40157
CONF-8512126-	(8. Brazilian Congress of Mechanical Engineering, Sao Jose dos Campos, Brazil, 1 Dec 1985)			
1	*See* INIS-BR-614	DE87702452	MN -25	12:38833
2	*See* INIS-BR-615	DE87702453	MN -80	12:38870
CONF-860102-	(3. symposium on space nuclear power systems, Albuquerque, NM, USA, 13-16 Jan 1986)			
15	*See* HEDL-SA-3391	E 1.99: DE87010722	MN -79b	12:38842
CONF-860117-	(Los Angeles symposium and exhibition on optical and electro-optical engineering, Los Angeles, CA, USA, 19-24 Jan 1986)			
19	*See* UCRL-93928	DE87009604	MN -38	12:39451
CONF-8601110-	(SERI photovoltaics safety conference, Lakewood, CO, USA, 16-17 Jan 1986)			
	Sol. Cells, 19: No. 3/4, 337-343(Jan 1987)			12:38732
	Sol. Cells, 19: No. 3/4, 345-353(Jan 1987)			12:38733
CONF-8601121-	(US/Japan workshop A-56 irradiation effects on plasma diagnostic equipment, Nagoya, Japan, 28-30 Jan 1986)			
Absts.	*See* IPPJ-779	DE87702503	MN -20	12:40153
CONF-860233-	(11. nuclear physics conference, Melbourne, Australia, 3-5 Feb 1986)			
Absts.	*See* INIS-mf-10911	DE87702489	MN -34C	12:39998
CONF-8602103-	(1. international conference on pervaporation processes in the chemical industry, Atlanta, GA, USA, 23-26 Feb 1986)			
1	*See* GKSS-86/E/54		ND -11	12:39629
CONF-8602126-	(Mass spectrometry conference, Irvine, CA, USA, 15 Feb 1986)			
1	*See* LBL-23323	E 1.99: DE87010975	MN -28	12:39492
CONF-8602133-	(Yosemite conference on ionospheric plasma in the magnetosphere: sources, mechanisms and consequences, Yosemite, CA, USA, 3-6 Feb 1986)			
Summ.	*See* N-87-20689			12:39875

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CONF-860311-	(Nuclear power plant maintenance meeting, Salt Lake City, UT, USA, 23-27 Mar 1986)			
15	*See* HEDL-SA-3380	E 1.99: DE87010721	MN -79	12:38887
CONF-860421-	(2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986)			
	J. Nucl. Mater., 141-143: No. B, 566-570(Nov-Dec 1986)			12:40234
	J. Nucl. Mater., 141-143: No. B, 579-583(Nov-Dec 1986)			12:40235
	J. Nucl. Mater., 141-143: No. B, 584-591(Nov-Dec 1986)			12:40236
	J. Nucl. Mater., 141-143: No. B, 592-598(Nov-Dec 1986)			12:40237
	J. Nucl. Mater., 141-143: No. B, 617-621(Nov-Dec 1986)			12:40238
	J. Nucl. Mater., 141-143: No. B, 633-646(Nov-Dec 1986)			12:40239
	J. Nucl. Mater., 141-143: No. B, 654-657(Nov-Dec 1986)			12:40240
	J. Nucl. Mater., 141-143: No. B, 658-664(Nov-Dec 1986)			12:40241
	J. Nucl. Mater., 141-143: No. B, 665-671(Nov-Dec 1986)			12:40242
	J. Nucl. Mater., 141-143: No. B, 690-694(Nov-Dec 1986)			12:40243
	J. Nucl. Mater., 141-143: No. B, 695-702(Nov-Dec 1986)			12:40244
	J. Nucl. Mater., 141-143: No. B, 705-712(Nov-Dec 1986)			12:40245
	J. Nucl. Mater., 141-143: No. B, 718-722(Nov-Dec 1986)			12:40246
	J. Nucl. Mater., 141-143: No. B, 727-730(Nov-Dec 1986)			12:40247
	J. Nucl. Mater., 141-143: No. B, 807-815(Nov-Dec 1986)			12:40248
	J. Nucl. Mater., 141-143: No. B, 816-823(Nov-Dec 1986)			12:40249
	J. Nucl. Mater., 141-143: No. B, 824-828(Nov-Dec 1986)			12:40250
	J. Nucl. Mater., 141-143: No. B, 860-864(Nov-Dec 1986)			12:40251
	J. Nucl. Mater., 141-143: No. B, 870-873(Nov-Dec 1986)			12:40252
	J. Nucl. Mater., 141-143: No. B, 874-877(Nov-Dec 1986)			12:40253
	J. Nucl. Mater., 141-143: No. B, 883-887(Nov-Dec 1986)			12:40254
	J. Nucl. Mater., 141-143: No. B, 888-892(Nov-Dec 1986)			12:40255
	J. Nucl. Mater., 141-143: No. B, 929-937(Nov-Dec 1986)			12:40256
	J. Nucl. Mater., 141-143: No. B, 943-947(Nov-Dec 1986)			12:40257
	J. Nucl. Mater., 141-143: No. B, 948-953(Nov-Dec 1986)			12:40258
	J. Nucl. Mater., 141-143: No. B, 960-965(Nov-Dec 1986)			12:40259
	J. Nucl. Mater., 141-143: No. B, 966-972(Nov-Dec 1986)			12:40260
	J. Nucl. Mater., 141-143: No. B, 973-977(Nov-Dec 1986)			12:40261
	J. Nucl. Mater., 141-143: No. B, 978-981(Nov-Dec 1986)			12:40262
	J. Nucl. Mater., 141-143: No. B, 982-986(Nov-Dec 1986)			12:40263
	J. Nucl. Mater., 141-143: No. B, 991-995(Nov-Dec 1986)			12:40264
	J. Nucl. Mater., 141-143: No. B, 996-999(Nov-Dec 1986)			12:40265
	J. Nucl. Mater., 141-143: No. B, 1018-1024(Nov-Dec 1986)			12:40266
	J. Nucl. Mater., 141-143: No. B, 1054-1056(Nov-Dec 1986)			12:40267
	J. Nucl. Mater., 141-143: No. B, 1057-1060(Nov-Dec 1986)			12:40268
	J. Nucl. Mater., 141-143: No. B, 1061-1063(Nov-Dec 1986)			12:40269
	J. Nucl. Mater., 141-143: No. B, 1074-1080(Nov-Dec 1986)			12:40270
	J. Nucl. Mater., 141-143: No. B, 1081-1087(Nov-Dec 1986)			12:40271
	J. Nucl. Mater., 141-143: No. B, 1117-1124(Nov-Dec 1986)			12:40272

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	J. Nucl. Mater., 141-143: No. B, 1125-1131(Nov-Dec 1986)			12:40273
76	*See* HEDL-SA-3416	E 1.99: DE87010720	MN -20c	12:40184
77	*See* HEDL-SA-3444	E 1.99: DE87010725	MN -20c	12:40185
CONF-860445-	(Materials Research Society spring meeting, Palo Alto, CA, USA, 15-18 Apr 1986) Pittsburgh, PA; Materials Research Society (1986).			12:39247
CONF-860477-	(Meeting customer needs with heat pumps: a seminar and exposition, Kansas City, MO, USA, 8-9 Apr 1986)			
	See EPRI-EM-5168	TI87920481	ND -95d	12:39060
CONF-8604297-	(16. international workshop on expert systems and their applications, Avignon, France, 28-30 Apr 1986)			
1	*See* HEDL-SA-3511-FP	E 1.99: DE87004438	MN -80	12:38918
CONF-8604322-	(46. annual symposium of the Deutsche Geophysikalische Gesellschaft e.V: joint symposium of the ILP-SFB 108 on the continental lithosphere - structure, composition and processes, Karlsruhe, F.R. Germany, 7-12 Apr 1986)			
	See INIS-mf-10632	DE87752245	MN -34B	12:39728
CONF-860548-	(8. international symposium on coal slurry fuels preparation and utilization, Orlando, FL, USA, 27-30 May 1986)			
6	NTIS, PC A02; 3	DE87011806	MN -102	12:38422
CONF-8605114-	(Properties and applications of metal hydrides, Maubuisson, France, 25-30 May 1986)			
	J. Less-Common Met., 129: vp(15 Feb 1987)			12:39244
CONF-8605280-	(Advanced instrumentation for aero engine components conference, Philadelphia, PA, USA, 19-23 May 1986)			
	See AGARD-CP-99			12:39528
CONF-860610-	(American Nuclear Society annual meeting, Reno, NV, USA, 15-20 Jun 1986)			
38	*See* HEDL-SA-3453	E 1.99: DE87010731	MN -79b	12:38917
CONF-860629-	(Linear accelerator conference, Stanford, CA, USA, 2-6 Jun 1986)			
79	*See* UCRL-94771	E 1.99: DE87009567	MN -28	12:39490
CONF-8606130-	(International conference on nuclear structure, reactions, and symmetries, Dubrovnik, Yugoslavia, 5-14 Jun 1986)			
13	*See* UCRL-94696	E 1.99: DE87009576	MN -34C	12:39519
CONF-8606134-	(4. international conference on muon spin rotation, relaxation and resonance, Uppsala, Sweden, 1 Jun 1986)			
	Hyperfine Interact., 32: No. 1-4, 893-900(Dec 1986)			12:39891
	Hyperfine Interact., 32: No. 1-4, 667-675(Dec 1986)			12:40124
	Hyperfine Interact., 32: No. 1-4, 595-600(Dec 1986)			12:40125
CONF-8606303-	(Colloquium of the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe G.m.b.H., Karlsruhe, F.R. Germany, 10-11 Jun 1986)			
	See KFK-4170		ND -80	12:38969
CONF-8606320-	(Heat exchanger workshop, Palo Alto, CA, USA, 10-11 Jun 1986)			
	See EPRI-EM-5256-SR	TI87920491	ND -97	12:38788
CONF-8606324-	(Closed-cycle, frequency-stable CO/sub 2/ laser technology, Hampton, VA, USA, 10-12 Jun 1986)			
	See N-87-20522			12:39393
CONF-860741-	(International symposium on weak and electromagnetic interactions in nuclei, Heidelberg, F.R. Germany, 1-5 Jul 1986)			
24	NTIS, PC A02; 3	DE87010896	MN -34C	12:39999
CONF-8607331-	(4. Hungarian conference on crystal growth (HCCG-4) with international participation and 1. international symposium on shaped crystal growth (SSCG-1), Budapest, Hungary, 22-25 Jul 1986)			
	J. Cryst. Growth, 82: No. 1/2, 182-190(Mar 1987)			12:39286
CONF-8607332-	(10. VDI colloquium: advancement of research for the 1990's, as seen by the German industry, Duesseldorf, F.R. Germany, 8 Jul 1986)			
1	NTIS (US Sales Only), PC A03; 3	DE87770209	MN -13	12:40279
CONF-860804-	(21. international symposium on combustion, Munich, F.R. Germany, 3-8 Aug 1986)			
14	*See* LBL-23463	E 1.99: DE87010983	MN -38	12:39343
CONF-860822-	(12. annual symposium on underground coal gasification, Saarbrucken, F.R. Germany, 25-28 Aug 1986)			
2	*See* UCRL-94418	DE87011882	MN -109	12:38443
3	*See* UCRL-94419	E 1.99: DE87011570	MN -109	12:38444
4	*See* UCRL-94422	E 1.99: DE87011572	MN -109	12:38445
CONF-860848-	(National conference on artificial intelligence, Philadelphia, PA, USA, 11-15 Aug 1986)			
4	*See* HEDL-SA-3504	E 1.99: DE87010730	MN -79p	12:38835
CONF-8608123-	(Advanced accelerator concepts conference, Madison, WI, USA, 21-27 Aug 1986)			
11-Rev.	*See* SLAC-PUB-3890-Rev.	E 1.99: DE87010539	MN -28	12:39447

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CONF-8608189-	(Alfred-Wegener conference on ground-based remote-sensing techniques for the troposphere, Hamburg, F.R. Germany, 25-28 Aug 1986)			
1	*See* GKSS-86/E/58		ND -11	12:39577
CONF-860906-	(Advances in reactor physics and safety meeting, Saratoga Springs, NY, USA, 17-19 Sep 1986)			
20	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004977	MN -80	12:38904
CONF-860911-	(192. American Chemical Society national meeting, Anaheim, CA, USA, 7-12 Sep 1986)			
24	*See* SAND-86-2892C	E 1.99: DE87004242	MN -80	12:38885
CONF-860990-	(8. annual participants' information meeting of the DOE Low-Level Waste Management Program, Denver, CO, USA, 22-26 Sep 1986)			
Pt.1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87012442	MN -70B	12:38604
Pt.2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012443	MN -70B	12:38605
Pt.3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012444	MN -70B	12:38606
Pt.4	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012445	MN -70B	12:38607
Pt.5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012446	MN -70B	12:38608
Pt.6	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012447	MN -70B	12:38609
Pt.7	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012448	MN -70B	12:38610
Pt.8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012449	MN -70B	12:38611
Summ.	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012441	MN -70B	12:38612
CONF-8609126-	(Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions, Palo Alto, CA, USA, 3-5 Sep 1986)			
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87004984	MN -80	12:38882
CONF-8609138-	(5. europhysical topical conference on lattice defects in ionic materials, Madrid, Spain, 8-12 Sep 1986)			
6-Summ.	*See* INIS-BR-647	DE87702482	MN -20	12:40187
CONF-8609146-	(Microgravity fluid management symposium, Cleveland, OH, USA, 9 Sep 1986)			
	See N-87-21141			12:39426
CONF-8609151-	(7. international symposium on high energy spin physics, Protvino, USSR, 22-27 Sep 1986)			
6	*See* DOE/ER/40304-1	E 1.99: DE87010364	MN -28	12:39491
CONF-8609159-	(International school-seminar on heavy ion physics, Dubna, USSR, 23-30 Sep 1986)			
9-Prepr.	*See* GSI-86-53-Prepr.		ND -4	12:39290
CONF-8609242-	(Robots west conference, Long Beach, CA, USA, 22-25 Sep 1986)			
2	*See* HEDL-SA-3410	E 1.99: DE87010729	MN -38	12:39355
CONF-8609273-	(1. Franco-Argentin symposium on materials science, Mar del Plata, Argentina, 29 Sep-3 Oct 1986)			
2	*See* CEA-CONF-8849	DE87752195	MN -25	12:39183
CONF-8609282-	(1. non destructive testing congress for Latin America and Caribbe, Sao Paulo, Brazil, 21-24 Sep 1986)			
1-Summ.	*See* INIS-BR-626	DE87702461	MN -41	12:40109
CONF-8609289-	(International symposium on heavy ion fusion, Washington, DC, USA, 24 Sep 1986)			
1-Rev.1	*See* UCRL-94348-Rev.1	E 1.99: DE87009616	MN -21	12:40228
CONF-8609299-	(17. trade union congress of IG Bergbau und Energie, Duisburg, F.R. Germany, 12 Sep 1986)			
	NTIS (US Sales Only), PC A05/MF A01; 1	DE87752614	MN -116	12:38492
CONF-861048-	(3. Brazilian petroleum congress, Rio de Janeiro, Brazil, 5-10 Oct 1986)			
1-Summ.	*See* INIS-BR-646	DE87702481	MN -4	12:39725
CONF-861061-	(International School of Heavy Ion Physics course on the response of nuclei under extreme conditions, Erice, Italy, 12-22 Oct 1986)			
3-Prepr.	*See* GSI-87-8-Prepr.		ND -34C	12:40052
CONF-861065-	(Seminar on management options for low and intermediate level wastes in Latin America, Rio de Janeiro, Brazil, 13-17 Oct 1986)			
Absts.	*See* IAEA-SR-110	DE87702447	MN -70	12:38628
CONF-8610115-	(4. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 27-31 Oct 1986)			
27	*See* BNL-39848	E 1.99: DE87010754	MN -28	12:39495
CONF-8610122-	(8. international electric vehicle symposium, Washington, DC, USA, 20-23 Oct 1986)			
	NTIS, PC A23/MF A01; 1 (GPO Dep.)	E 1.99: DE87010697	MN -96	12:39161
CONF-8610196-	(European workshop on few body physics, Rome, Italy, 7-11 Oct 1986)			
6	*See* DOE/ER/40150-17	E 1.99: DE87008665	MN -34C	12:40051
CONF-8610220-	(DOE contractors meeting, Pittsburgh, PA, USA, 21-22 Oct 1986)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009769	MN -108	12:38428
CONF-8610259-	(12. national technology meeting of welding technology, Campos do Jordao, Brazil, 1 Oct 1986)			
2	*See* INIS-BR-645	DE87702480	MN -80	12:38871
CONF-8610274-	(Autumn meeting of Oesterreichische Gesellschaft fuer Erdoelwissenschaften (OeGEW), Leoben, Austria, 23-24 Oct 1986)			
Absts.	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752238	MN -121	12:38513

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CONF-8610277-	(2. national meeting on librarianship and informatics; 2. national meeting on legal information and documentation, Brasilia, Brazil, 26-31 Oct 1986)			
1	*See* INIS-BR-617	DE87702454	MN -2	12:40314
2	*See* INIS-BR-618	DE87702455	MN -2	12:40315
3	*See* INIS-BR-619	DE87702456	MN -78	12:38804
CONF-8610278-	(34. Brazilian congress of geology, Goiania, Brazil, 12-29 Oct 1986)			
1-Summ.	*See* INIS-BR-627	DE87702462	MN -51	12:39721
2-Summ.	*See* INIS-BR-628	DE87702463	MN -51	12:39722
3-Summ.	*See* INIS-BR-629	DE87702464	MN -51	12:39723
4-Summ.	*See* INIS-BR-630	DE87702465	MN -51	12:39724
5-Summ.	*See* INIS-BR-631	DE87702466	MN -51	12:38555
6-Summ.	*See* INIS-BR-632	DE87702467	MN -51	12:38556
7-Summ.	*See* INIS-BR-633	DE87702468	MN -51	12:38557
8-Summ.	*See* INIS-BR-634	DE87702469	MN -51	12:38558
9-Summ.	*See* INIS-BR-635	DE87702470	MN -4	12:39292
10-Summ.	*See* INIS-BR-636	DE87702471	MN -51	12:38559
11-Summ.	*See* INIS-BR-637	DE87702472	MN -51	12:38560
12-Summ.	*See* INIS-BR-638	DE87702473	MN -51	12:38561
13-Summ.	*See* INIS-BR-639	DE87702474	MN -51	12:38562
14-Summ.	*See* INIS-BR-640	DE87702475	MN -11	12:39640
15-Summ.	*See* INIS-BR-641	DE87702476	MN -51	12:39618
16-Summ.	*See* INIS-BR-642	DE87702477	MN -4	12:39731
17-Summ.	*See* INIS-BR-643	DE87702478	MN -51	12:39293
18-Summ.	*See* INIS-BR-644	DE87702479	MN -51	12:38563
CONF-8610285-	(Heavy ion fusion symposium, Washington, DC, USA, 1 Oct 1986)			
1-Rev.1	*See* UCRL-93046-Rev.1	E 1.99: DE87008743	MN -21	12:40227
CONF-8610299-	(Processing for reliability of advanced ceramics, Corning, NY, USA, 21-22 Oct 1986)			
1-Ext.-Abst.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012216	MN -25	12:39439
CONF-8610300-	(EPRI cogeneration symposium, Washington, DC, USA, 14-15 Oct 1986)			
	See EPRI-EM-5285	TI87920505	ND -95f	12:39158
CONF-8610301-	(Symposium on seismic and geologic siting criteria for nuclear power plants, Rockville, MD, USA, 7-9 Oct 1986)			
Summ.	*See* NUREG/CP-0087	TI87011025	MN -80	12:38883
CONF-8611176-	(Power plant performance monitoring and system dispatch conference, Washington, DC, USA, 12-14 Nov 1986)			
	See EPRI-CS/EL-5251-SR	TI87920514	ND -93	12:38787
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)			
110	*See* BNL-39898	DE87011292	MN -25	12:39255
CONF-861211-	(American Society of Mechanical Engineers winter meeting, Anaheim, CA, USA, 7-12 Dec 1986)			
20	*See* PNL-SA-13704	E 1.99: DE87003174	MN -80	12:38840
CONF-861262-	(SFEN conference on fast reactors and the startup of superphenix, Paris, France, 10-11 Dec 1986)			
11	*See* CEA-CONF-8914	DE87752642	MN -25	12:39184
CONF-861271-	(5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators, Berkeley, CA, USA, 1-2 Dec 1986)			
1	*See* LBL-23413	E 1.99: DE87011227	MN -28	12:39483
CONF-870102-	(4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987)			
1	*See* UCRL-95047	E 1.99: DE86014449	MN -77	12:38843
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002404	MN -80	12:38841
CONF-870132-	(OE/LASE '87, Los Angeles, CA, USA, 11-16 Jan 1987)			
8	*See* UCRL-96329	E 1.99: DE87010814	MN -28	12:39412
9	*See* BNL-39816	DE87010757	MN -38	12:39438
10	*See* BNL-39817	DE87010758	MN -38	12:39350
11	*See* BNL-39818	DE87010759	MN -38	12:39536
12	*See* UCRL-95881	E 1.99: DE87008848	MN -38	12:39411
CONF-870152-	(Workshop on opportunities for atomic physics using slow, highly-charged ions, Argonne, IL, USA, 12-13 Jan 1987)			
3	*See* BNL-39861	E 1.99: DE87010762	MN -34A	12:39880
CONF-870164-	(7. Moriond workshop: searches for new and exotic phenomena, Les Arcs, France, 24-31 Jan 1987)			
4	*See* LBL-23469	E 1.99: DE87012885	MN -34B	12:39905
CONF-870207-	(16. plasma physics conference, Lucas Heights, Australia, 9-11 Feb 1987)			
1	*See* INIS-mf-10914	DE87702491	MN -20	12:40188
CONF-870210-	(10. energy sources technology conference and exhibition, Dallas, TX, USA, 15-18 Feb 1987) American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:39012
CONF-870278-	(4. family of quarks and leptons international symposium, Santa Monica, CA, USA, 26-28 Feb 1987)			
3	*See* SLAC-PUB-4270	E 1.99: DE87010545	MN -34D	12:39949

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CONF-870282-	(8. summer school of nuclear and particle physics, Launceston, Australia, 2-6 Feb 1987)			
1	*See* LA-UR-87-782	E 1.99: DE87007477	MN -34C	12:40088
CONF-870301-	(International topical meeting on remote systems and robotics in hostile environments, Pasco, WA, USA, 29 Mar-2 Apr 1987)			
20	*See* UNI-SA-174	E 1.99: DE87003840	MN -80	12:38660
23	*See* PNL-SA-14058	DE87011157	MN -38	12:39364
24	*See* PNL-SA-14440	E 1.99: DE87011141	MN -38	12:39365
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)			
153	*See* LBL-22211	E 1.99: DE87009153	MN -28	12:40219
185	*See* BNL-39594	DE87010052	MN -28	12:39506
192	*See* SLAC-PUB-4199	DE87010319	MN -28	12:39493
195	*See* FNAL-TM-1451	DE87010300	STD -28	12:39496
197	*See* SLAC-PUB-4101	DE87010321	MN -28	12:39502
199	*See* SLAC-PUB-4208	DE87010318	MN -28	12:39489
202-Summ.	*See* LBL-23007	E 1.99: DE87011095	MN -28	12:39499
205	*See* LBL-22266	E 1.99: DE87011092	MN -28	12:39498
212	*See* ANL-HEP-87-29	DE87011501	MN -28	12:39505
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)			
57	*See* PNL-SA-14680	DE87011142	MN -78	12:38809
CONF-870307-	(ASME/JSME/ISES solar energy conference, Honolulu, HI, USA, 22-27 Mar 1987)			
23	*See* PNL-SA-14030	E 1.99: DE87011992	MN -59A	12:38751
CONF-870324-	(12. international conference on slurry technology, New Orleans, LA, USA, 30 Mar-3 Apr 1987)			
2	*See* PNL-SA-14508	E 1.99: DE87012164	MN -70	12:38647
CONF-870359-	(5. seminar on magnetohydrodynamic flows and turbulence, Jerusalem, Israel, 2-6 Mar 1987)			
2	*See* DOE/ER/53223-32	E 1.99: DE87011088	MN -20	12:40139
CONF-870388-	(International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Mar 1987)			
13	NTIS, PC A02/MF A01; 3	DE87011521	MN -25	12:39222
CONF-870396-	(Lunar and planetary science conference, Houston, TX, USA, 16-20 Mar 1987)			
4	*See* LA-UR-87-1995	E 1.99: DE87011776	MN -34B	12:39746
CONF-8703118-	(NATO advanced study institute conference on time dependent effects in disordered materials, Geilo, Norway, 29 Mar-9 Apr 1987)			
3	*See* LA-UR-87-1418	E 1.99: DE87009011	MN -34	12:40127
CONF-8703128-	(International conference on advances in experimental methods for colliding beam physics, Stanford, CA, USA, 9-13 Mar 1987)			
1	*See* SLAC-PUB-4297	E 1.99: DE87010315	MN -28	12:39517
3	*See* SLAC-PUB-4317	DE87010845	MN -28	12:39518
4	*See* SLAC-PUB-4303	DE87010844	MN -28	12:39503
CONF-8703136-	(Elementary structure of materials, Les Houches, France, 24 Mar-2 Apr 1987)			
2	*See* BNL-39780	E 1.99: DE87010440	MN -34B	12:39738
CONF-8703155-	(CASA/SME CIMTECH meeting, Los Angeles, CA, USA, 27 Mar 1987)			
1	*See* Y/CM-0071	E 1.99: DE87012330	MN -13	12:40298
CONF-870410-	(193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987)			
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 425-432(Apr 1987)			12:38424
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 433-440(Apr 1987)			12:38425
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 486-491(Apr 1987)			12:38446
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 478-485(Apr 1987)			12:38447
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 94-97(Apr 1987)			12:38448
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 98-106(Apr 1987)			12:38449
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 589-597(Apr 1987)			12:38450
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 598-603(Apr 1987)			12:38451
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 611-616(Apr 1987)			12:38452
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 617-627(Apr 1987)			12:38453
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 628-636(Apr 1987)			12:38454
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 637-642(Apr 1987)			12:38455
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 1-8(Apr 1987)			12:38466
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 49-61(Apr 1987)			12:38467

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	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 62-69(Apr 1987)			12:38468
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 70-81(Apr 1987)			12:38469
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 107-117(Apr 1987)			12:38470
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 129-137(Apr 1987)			12:38471
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 171-178(Apr 1987)			12:38472
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 247-258(Apr 1987)			12:38473
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 298-309(Apr 1987)			12:38474
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 337-347(Apr 1987)			12:38475
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 378-385(Apr 1987)			12:38476
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 417-424(Apr 1987)			12:38477
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 448-456(Apr 1987)			12:38478
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 457-462(Apr 1987)			12:38479
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 492-499(Apr 1987)			12:38480
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 500-504(Apr 1987)			12:38481
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 554-557(Apr 1987)			12:38482
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 558-563(Apr 1987)			12:38483
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 564-570(Apr 1987)			12:38484
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 576-582(Apr 1987)			12:38485
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 583-588(Apr 1987)			12:38486
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 604-610(Apr 1987)			12:38487
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 530-537(Apr 1987)			12:38550
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 471-477(Apr 1987)			12:39325
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 1, 505-512(Apr 1987)			12:39586
29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011426	MN -34C	12:40047
32	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011529	MN -101	12:38458
CONF-870413-	(11. international conference on particles and nuclei, Kyoto, Japan, 20-24 Apr 1987)			
3	*See* LBL-23373	E 1.99: DE87012033	MN -34B	12:39750
CONF-870418-	(Topical meeting on anticipated and abnormal transients in nuclear power plants, Atlanta, GA, USA, 12-15 Apr 1987)			
5	*See* BNL-NUREG-39850	E 1.99: DE87010756	MN -80	12:38903
CONF-870422-	(89. annual meeting of the American Ceramic Society, Pittsburgh, PA, USA, 26-30 Apr 1987)			
6	*See* EGG-M-35686	E 1.99: DE87012432	MN -25	12:39261
CONF-870429-	(6. annual conference on incineration of mixed and low-level radioactive wastes, St. Charles, IL, USA, 22-25 Apr 1987)			
2	*See* DP-MS-87-42	E 1.99: DE87011176	MN -70B	12:38618
CONF-870436-	(14. annual national organization for professional advancement of black chemists and chemical engineers, San Francisco, CA, USA, 13-18 Apr 1987)			
1	*See* Y/DV-605/R2	E 1.99: DE87012329	MN -4	12:39269
CONF-870437-	(Workshop on chemical reactivity of oxide fuel and fission product release, Gloucestershire, UK, 6-9 Apr 1987)			
2	*See* PNL-SA-14821	E 1.99: DE87011143	MN -78	12:38648
CONF-870438-	(Spring meeting of the Materials Research Society, Anaheim, CA, USA, 21-25 Apr 1987)			
21	*See* UCRL-95609	E 1.99: DE87010876	MN -25	12:39209
29	*See* SAND-86-2658C	E 1.99: DE87012103	MN -25	12:39233
30	*See* SAND-87-1656C	E 1.99: DE87012017	MN -25	12:39267
CONF-870450-	(Symposium on verification and validation of geosphere performance assessment models, Stockholm, Sweden, 7-9 Apr 1987)			
2	*See* PNL-SA-14836	E 1.99: DE87012166	MN -70	12:38649
CONF-870457-	(Annual meeting of Fusion Power Associates, Pleasanton, CA, USA, 8-9 Apr 1987)			
2	*See* PFC/CP-87-1	DE87900826	MN -20	12:40220

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CONF-870466-	(International conference on environmental degradation of engineering materials, University Park, PA, USA, 13-15 Apr 1987)				
4	*See* N-87-20425				12:39231
CONF-8704110-	(5. geothermal program review, Washington, DC, USA, 14-15 Apr 1987)				
11	*See* UCRL-96509		DE87011567	MN -66a	12:38769
12	*See* UCRL-96511		DE87011568	MN -66a	12:38770
CONF-8704116-	(IMOG metal forming modeling subgroup, Livermore, CA, USA, 22-24 Apr 1987)				
2-Abst.	*See* UCRL-93745	E 1.99:	DE87010806	MN -38	12:39371
CONF-8704137-	(MGUS '87, Redwood City, CA, USA, 13-15 Apr 1987)				
2	*See* SAND-87-7106C	E 1.99:	DE87011721	MN -11	12:39017
CONF-8704138-	(Conference on similarities and dissimilarities of comets, Brussels, Belgium, 6-9 Apr 1987)				
1	*See* LA-UR-87-1793	E 1.99:	DE87010139	MN -34B	12:39745
CONF-8704143-	(Integrated contractors meeting on coatings and SUBWOG 12A, Kansas City, MO, USA, 27-29 Apr 1987)				
1	*See* SAND-87-0868C		DE87010436	MN -38	12:39205
CONF-8704152-	(Workshop on tests of time reversal invariance in neutron physics, Chapel Hill, NC, USA, 17-19 Apr 1987)				
1	*See* DOE/ER/40048-23-N7		DE87011080	MN -34C	12:39967
CONF-8704164-	(15. environmental symposium, Long Beach, CA, USA, 28-30 Apr 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008596	MN -11	12:39602
CONF-8704169-	(7. annual AGU Front Range Branch hydrology days conference, Fort Collins, CO, USA, 21-23 Apr 1987)				
1	*See* PNL-SA-14861	E 1.99:	DE87011987	MN -11	12:39727
CONF-8704171-	(International symposium on magnetism of intermetallic compounds, Kyoto, Japan, 20-22 Apr 1987)				
1	*See* BNL-39823	E 1.99:	DE87010789	MN -25	12:39254
CONF-8704173-	(Annual meeting of the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH), Brisbane, Australia, 6-10 Apr 1987)				
1	*See* PNL-SA-14671	E 1.99:	DE87011991	MN -95d	12:39109
CONF-8704176-	(CASA/SME seminar, Chicago, IL, USA, 28-30 Apr 1987)				
1	*See* Y/DW-708	E 1.99:	DE87012327	MN -13	12:40299
CONF-8704178-	(10. INS-Kikuchi spring school on quarks and nuclei, Shimoda, Japan, 15-18 Apr 1987)				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011147	MN -34D	12:40049
2	*See* LA-UR-87-2127	E 1.99:	DE87011745	MN -34C	12:40089
CONF-870523-	(9. symposium on biotechnology for fuels and chemicals, Boulder, CO, USA, 5-8 May 1987)				
4	*See* SERI/TP-231-3161	E 1.99:	DE87001194	MN -61	12:38731
CONF-870534-	(Conference on health effects of low dose ionizing radiation: recent advances and their applications, London, UK, 11-14 May 1987)				
1	*See* PNL-SA-14684	E 1.99:	DE87011990	MN -41	12:39686
CONF-870552-	(5. conference on real-time computer applications in nuclear, particle, and plasma physics, San Francisco, CA, USA, 11-15 May 1987)				
13	*See* LA-UR-87-1563	E 1.99:	DE87010111	MN -32	12:40286
16	*See* DOE/ET/51013-217		DE87011032	MN -20	12:40180
CONF-870558-	(19. international electric propulsion conference, Colorado Springs, CO, USA, 11-13 May 1987)				
3	*See* N-87-20382				12:39159
CONF-870564-	(Socioeconomic energy research and analysis conference, Washington, DC, USA, 21-22 May 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011434	MN -98G	12:39009
4	*See* PNL-SA-14967	E 1.99:	DE87011986	MN -98	12:39008
CONF-870570-	(7. topical conference on applications of radio-frequency power to plasmas, Kissimmee, FL, USA, 4-6 May 1987)				
8	*See* UCRL-96416	E 1.99:	DE87009852	MN -20a	12:40164
14	*See* DOE/ET/51013-216	E 1.99:	DE87011031	MN -20b	12:40142
16	*See* DOE/ET/51013-219	E 1.99:	DE87011034	MN -20	12:40143
17	*See* DOE/ET/51013-220	E 1.99:	DE87011035	MN -20	12:40144
CONF-870584-	(Technical symposium southeast on optics, electro-optics and sensors, Orlando, FL, USA, 17-22 May 1987)				
7	*See* UCRL-95404	E 1.99:	DE87010338	MN -28	12:39504
8	*See* SAND-87-1268C	E 1.99:	DE87010744	MN -37	12:39538
CONF-8705103-	(Fossil energy materials program conference, Oak Ridge, TN, USA, 19-21 May 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011938	MN -114	12:39189
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011937	MN -114	12:38429
8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011452	MN -114	12:38430
CONF-8705107-	(SIGMOD '87 conference, San Francisco, CA, USA, 27-29 May 1987)				
2	*See* LBL-22636	E 1.99:	DE87011221	MN -32	12:40318

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CONF-8705111-	(TIMS/ORSA joint national meeting, New Orleans, LA, USA, 4-6 May 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010016	MN -32	12:40311
CONF-8705114-	(35. conference on mass spectrometry and applied topics, Denver, CO, USA, 24-29 May 1987)			
3	*See* PNL-SA-14688	E 1.99: DE87012159	MN -4	12:39297
4	*See* PNL-SA-14689	E 1.99: DE87012160	MN -4	12:39298
CONF-8705121-	(Atomic Industrial Forum international conference, San Francisco, CA, USA, 26-29 May 1987)			
1	*See* K/OA-6076	E 1.99: DE87009814	MN -22	12:38566
CONF-8705123-	(International meeting on synchrotron radiation applications to digital subtraction angiography, Frascati, Italy, 6-8 May 1987)			
1	*See* BNL-39792	DE87010761	MN -28	12:39652
CONF-8705125-	(I.R.I. advanced study group 7B: overcoming roadblocks to R and D goals, Chicago, IL, USA, 13-15 May 1987)			
1-Vugraphs	NTIS, PC A02; 3	DE87009677	MN -20	12:40175
CONF-8705134-	(Workshop on radiological aspects of SSC operation, Berkeley, CA, USA, 4-6 May 1987)			
1	*See* FNAL-TM-1462	E 1.99: DE87010996	STD -28	12:39638
2	*See* FNAL-TM-1461	E 1.99: DE87010997	STD -28	12:39481
3	*See* FNAL-TM-1459	E 1.99: DE87010999	STD -28	12:39479
4	*See* FNAL-TM-1460	E 1.99: DE87010998	STD -28	12:39480
CONF-8705140-	(Department of Energy workshop on electron cyclotron heating, Germantown, MD, USA, 4-6 May 1987)			
1	*See* GA-A-18795	E 1.99: DE87009860	MN -20a	12:40183
CONF-8705145-	(Advances in fouling science and technology, Braga, Portugal, 19-30 May 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011427	MN -64	12:38755
CONF-8705147-	(Piecing the puzzle together: a conference on integrating data for decisionmaking, Washington, DC, USA, 27-29 May 1987)			
1	*See* BNL-39865	E 1.99: DE87011302	MN -11	12:39561
CONF-8705149-	(Symposium on measurement of toxic and related air pollutants, Research Triangle Park, NC, USA, 3-6 May 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011456	MN -11	12:39574
CONF-8705154-	(21. Pacific Northwest Regional Economic conference, Seattle, WA, USA, 1 May 1987)			
2	*See* PNL-SA-14640	E 1.99: DE87012165	MN -11	12:39015
CONF-8705155-	(North American workshop on cataclysmic variables, Aspen, CO, USA, 25-29 May 1987)			
1	*See* UCRL-96673	DE87011346	MN -34B	12:39867
CONF-8705158-	(Symposium on parity non-conservation, Vancouver, UK, 28-29 May 1987)			
1	*See* LA-UR-87-2126	E 1.99: DE87011746	MN -34C	12:39904
CONF-8705160-	(7. North American conference on mycorrhizae, Gainesville, FL, USA, 3-8 May 1987)			
2	NTIS, PC A02; 3	DE87012218	MN -48	12:39670
CONF-870620-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting, Nashville, TN, USA, 28 Jun-2 Jul 1987)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011449	MN -95d	12:39154
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011647	MN -95d	12:39051
9	NTIS, PC A02; 3	DE87012251	MN -95	12:39052
CONF-870621-	(78. International District Heating and Cooling Association conference, Baltimore, MD, USA, 21-25 Jun 1987)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011446	MN -95d	12:39155
CONF-870623-	(22. AIAA thermophysics conference, Honolulu, HI, USA, 8-10 Jun 1987)			
6	*See* LA-UR-87-1480	E 1.99: DE87010099	MN -28	12:39392
CONF-870625-	(Rock mechanics meeting, Tucson, AZ, USA, 29 Jun-1 Jul 1987)			
16	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011443	MN -11	12:39730
CONF-870629-	(14. European conference on controlled fusion and plasma physics, Madrid, Spain, 22-26 Jun 1987)			
7	*See* DOE/ET/51013-222	E 1.99: DE87011037	MN -20a	12:40145
8-Abst.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010886	MN -20a	12:40174
CONF-870656-	(6. Institute of Electrical and Electronic Engineers pulsed power conference, Arlington, VA, USA, 29 Jun-1 Jul 1987)			
4	*See* SAND-87-0083C	E 1.99: DE87011060	MN -28	12:39501
CONF-870658-	(International conference on localized corrosion, Orlando, FL, USA, 1-5 Jun 1987)			
1	*See* LBL-23474	E 1.99: DE87012819	MN -25	12:39201
3	*See* BNL-40004	E 1.99: DE87012488	MN -25	12:39182
CONF-870659-	(7. annual gasification systems conference, Morgantown, WV, USA, 16-19 Jun 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012538	MN -114	12:38797

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CONF-870661-	(11. actinide separations conference, Livermore, CA, USA, 1-4 Jun 1987)			
9	*See* DP-MS-87-12	E 1.99: DE87012384	MN -10	12:38570
CONF-870664-	(25. symposium on engineering aspects of magneto-hydrodynamics, Bethesda, MD, USA, 24-26 Jun 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011437	MN -112	12:39047
CONF-870677-	(6. IMACS international symposium on computer methods for partial differential equations, Bethlehem, PA, USA, 23-26 Jun 1987)			
5	*See* SAND-87-0022C	E 1.99: DE87010497	MN -32	12:40289
CONF-870695-	(80. annual meeting of the Air Pollution Control Association, New York, NY, USA, 1 Jun 1987)			
6	*See* PNL-SA-14337	E 1.99: DE87012062	MN -11	12:39108
CONF-8706108-	(Maintenance seminar, Oak Ridge, TN, USA, 2-3 Jun 1987)			
2	*See* UCRL-96708	E 1.99: DE87010809	MN -38	12:39372
CONF-8706111-	(12. annual meeting and international symposium of the Technology Transfer Society, Washington, DC, USA, 22-25 Jun 1987)			
1	*See* BNL-39708	E 1.99: DE87010368	MN -28	12:39445
CONF-8706113-	(6. Adriatic international conference on nuclear physics, Dubrovnik, Yugoslavia, 15-19 Jun 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011178	MN -34C	12:40007
CONF-8706115-	(Rochester FORTH conference, Rochester, NY, USA, 9-13 Jun 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010591	MN -32	12:40283
CONF-8706116-	(16. international symposium on acoustic imaging, Chicago, IL, USA, 10-12 Jun 1987)			
1	*See* BDX-613-3700	E 1.99: DE87010677	MN -38	12:39437
CONF-8706117-	(Symposium on standardization of terminology: theory and practice, Cincinnati, OH, USA, 24 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009827	MN -38	12:39348
CONF-8706122-	(Artificial intelligence and robotics symposium, Norfolk, VA, USA, 16-17 Jun 1987)			
1	*See* SAND-87-0646C	E 1.99: DE87010685	MN -38	12:39368
CONF-8706125-	(Conference on advances in cryogenic engineering, St. Charles, IL, USA, 14-18 Jun 1987)			
1	*See* UCRL-96002	E 1.99: DE87010807	MN -20	12:40230
8	NTIS, PC A02; 3	DE87012525	MN -25	12:39224
CONF-8706130-	(1. IEEE international conference on neural networks, San Diego, CA, USA, 21-24 Jun 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011125	MN -38	12:39352
CONF-8706132-	(Annual CNA/CNS conference, St. John, Canada, 15-17 Jun 1987)			
1	*See* SAND-87-0608C	E 1.99: DE87010780	MN -78	12:38991
CONF-8706133-	(IEEE international conference on plasma science, Washington, DC, USA, 1-3 Jun 1987)			
1-Abst.	*See* SAND-87-0482C	DE87010493	MN -21	12:39367
CONF-8706143-	(IAU colloquium 95, Tucson, AZ, USA, 1-5 Jun 1987)			
1	*See* LA-UR-87-2132	E 1.99: DE87011744	MN -34B	12:39748
2	*See* LA-UR-87-2010	E 1.99: DE87011773	MN -34B	12:39747
CONF-8706166-	(International symposium on medium energy physics, Beijing, China, 23-27 Jun 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011643	MN -34C	12:40050
CONF-870701-	(8. international congress of radiation research, Edinburgh, UK, 19-24 Jul 1987)			
1	*See* BNL-39942	E 1.99: DE87012125	MN -4	12:39316
CONF-870706-	(Summer computer simulation conference, Montreal, Canada, 27-29 Jul 1987)			
1	*See* N-87-20767			12:40288
CONF-870713-	(28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987)			
19	*See* SAND-87-1809C	E 1.99: DE87012012	MN -15	12:38655
20	*See* SAND-87-1583C	E 1.99: DE87012013	MN -15	12:38680
21	*See* K/ITP-105	E 1.99: DE87012323	MN -15	12:38674
22	*See* K/ITP-103	DE87012239	MN -15	12:38672
23	*See* K/ITP-104	E 1.99: DE87012322	MN -15	12:38673
24	*See* SAND-87-1021C	E 1.99: DE87012018	MN -15	12:38678
26	*See* SAND-87-1039C	E 1.99: DE87012010	MN -15	12:38679
29	*See* BNL-39984	E 1.99: DE87012490	MN -15	12:38669
30	*See* SAND-87-1744C	DE87012732	MN -71	12:38578
31	*See* DP-MS-87-31	E 1.99: DE87012381	MN -16	12:38671
CONF-870719-	(2. international conference on phase transformations in solids, Cambridge, UK, 6-10 Jul 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011940	MN -25	12:39185
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011941	MN -25	12:39186
CONF-870723-	(18. international conference on phenomena in ionized gases, Swansea, UK, 13-17 Jul 1987)			
2	*See* LA-UR-87-156	E 1.99: DE87005104	MN -34B	12:40131

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CONF-870733-	(Pacific workshop and meeting on analytical electron microscopy, Kona, HI, USA, 12-17 Jul 1987)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012521	MN -25	12:39187
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012542	MN -25	12:39188
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012537	MN -25	12:39223
CONF-870753-	(5. topical conference of the American Physical Society on shockwaves in condensed matter, Monterey, CA, USA, 20-23 Jul 1987)			
3	*See* SAND-87-0773C	E 1.99: DE87011319	MN -34	12:40118
4	*See* UCRL-96434	E 1.99: DE87011325	MN -34	12:39894
6	*See* UCRL-96431	E 1.99: DE87011548	MN -34	12:39210
7	*See* LA-UR-87-2233	DE87011729	MN -34	12:40117
9	*See* LA-UR-87-2221	E 1.99: DE87011731	MN -34B	12:39349
10	*See* SAND-87-0726C	E 1.99: DE87011315	MN -34	12:40293
13	*See* SAND-87-0649C	E 1.99: DE87011062	MN -34	12:40292
17	*See* SAND-87-0933C	E 1.99: DE87012136	MN -4	12:39266
18	*See* SAND-87-0668C	E 1.99: DE87012134	MN -25	12:39177
19	*See* SAND-87-1041C	DE87012364	MN -25	12:39207
23	*See* SAND-87-0915C	DE87012133	MN -25	12:39265
25	*See* SAND-87-0764C	DE87011724	MN -45	12:39546
30	*See* SAND-87-0955C	E 1.99: DE87012404	MN -25	12:39206
32	*See* SAND-87-0930C	DE87012406	MN -25	12:39537
34	*See* UCRL-96525	DE87012625	MN -4	12:39320
35	*See* UCRL-96493	DE87012626	MN -4	12:39178
37	*See* UCRL-96472	DE87012630	MN -4	12:39547
CONF-870754-	(11. international AIRAPT conference, Kiev, USSR, 12-17 Jul 1987)			
2	*See* LA-UR-87-2228	E 1.99: DE87011730	MN -34	12:40116
CONF-870757-	(IEEE Power Engineering Society summer meeting, San Francisco, CA, USA, 12-17 Jul 1987)			
3	*See* SAND-87-1124C	DE87011635	MN -63	12:38747
CONF-870771-	(Evaluation of environmental radiation exposures from nuclear testing in Nevada, Salt Lake City, UT, USA, 9-10 Jul 1987)			
1	*See* LA-UR-87-1955	E 1.99: DE87011782	MN -41	12:39684
CONF-870773-	(Workshop on biological treatment of coals, Washington, DC, USA, 8-10 Jul 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011943	MN -101	12:38427
CONF-870776-	(Symposium on acousto-ultrasonics, Blacksburg, VA, USA, 12-15 Jul 1987)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011394	MN -25	12:39256
CONF-870778-	(NATO/SHAPE EMP protection technical symposium, Brussels, Belgium, 13-17 Jul 1987)			
1	*See* LA-UR-87-1935	E 1.99: DE87011785	MN -13	12:39553
CONF-870780-	(34. international field emission symposium, Osaka, Japan, 13-18 Jul 1987)			
1	*See* SAND-87-1703C	E 1.99: DE87012401	MN -25	12:39208
CONF-870804-	(22. intersociety energy conversion engineering conference, Philadelphia, PA, USA, 10-14 Aug 1987)			
3-Draft	*See* SAND-86-1959C	E 1.99: DE87009846	MN -62b	12:38752
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010404	MN -94a	12:38999
9	*See* SAND-87-0021C	E 1.99: DE87010475	MN -38	12:39366
11	*See* LA-UR-87-1623	E 1.99: DE87010118	MN -94a	12:39000
15	NTIS, PC A02; 3	DE87011387	MN -62b	12:38749
CONF-870811-	(Energy conservation program evaluation: practical methods and useful results, Chicago, IL, USA, 19-21 Aug 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010602	MN -95d	12:39053
CONF-870812-	(9. SMIRT: international conference on structural mechanics in reactor technology, Lausanne, Switzerland, 17-21 Aug 1987)			
4	*See* SAND-86-1648C	DE87006120	MN -80	12:38989
6	*See* SAND-86-1676C	E 1.99: DE87006130	MN -78	12:38990
7	*See* UCRL-95021	E 1.99: DE87006240	MN -21	12:40229
9	*See* HEDL-SA-3665-FP	E 1.99: DE87007437	MN -80	12:38869
10	*See* BNL-NUREG-39597	DE87008717	MN -80	12:38863
CONF-870816-	(Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference, Pittsburgh, PA, USA, 9-12 Aug 1987)			
9	*See* BNL-NUREG-39222	TI87005862	MN -78	12:38901
10	*See* UCRL-96078	E 1.99: DE87005922	MN -38	12:39432
11	*See* SAND-86-2559C	E 1.99: DE87006711	MN -20a	12:40221
17	*See* EGG-M-34386	E 1.99: DE87009720	MN -78	12:38865
18	*See* BNL-NUREG-39762	E 1.99: DE87010462	MN -78	12:38864
19	*See* BNL-NUREG-39637	DE87009142	MN -78	12:38902
20	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011118	MN -95d	12:39054
23	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011458	MN -95d	12:39156
CONF-870822-	(American Institute of Chemical Engineers summer national meeting, Minneapolis, MN, USA, 16-19 Aug 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012249	MN -85	12:38613
CONF-870830-	(AIAA aerodynamics flight mechanics conference, Monterey, CA, USA, 17-19 Aug 1987)			
2	*See* SAND-86-2875C	E 1.99: DE87003790	MN -38	12:39430

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CONF-870831-	(International conference on parallel processing, St. Charles, IL, USA, 17-21 Aug 1987)			
1	*See* LA-UR-86-4356	E 1.99: DE87003759	MN -32	12:40285
2-Rev.1	*See* UCRL-96033-Rev.1	E 1.99: DE87007448	MN -32	12:40297
CONF-870841-	(2. international conference on human-computer interaction, Honolulu, HI, USA, 10-15 Aug 1987)			
1	*See* SAND-87-0349C	E 1.99: DE87007023	MN -21	12:40222
2	*See* SAND-87-0584C	E 1.99: DE87008646	MN -32	12:40291
CONF-870852-	(ASME computers in engineering conference, New York, NY, USA, 9-13 Aug 1987)			
1	*See* SAND-87-0864C	E 1.99: DE87007843	MN -38	12:39370
2	*See* SAND-87-0810C	E 1.99: DE87007863	MN -38	12:39369
CONF-870853-	(INDOOR AIR '87: 4th international conference on indoor air quality and climate, Berlin, F.R. Germany, 17-21 Aug 1987)			
3-Ext.-Abst.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87007732	MN -11	12:39571
CONF-870855-	(20. international cosmic ray conference, Moscow, USSR, 2-15 Aug 1987)			
1	*See* BNL-39602	E 1.99: DE87008376	MN -34B	12:39737
5	*See* ANL-HEP-CP-87-36	E 1.99: DE87011493	MN -34B	12:39735
CONF-870859-	(9. annual low-level radioactive waste management program conference, Denver, CO, USA, 25-27 Aug 1987)			
1-Summ.	*See* DP-MS-87-88	E 1.99: DE87012386	MN -70B	12:38666
CONF-870862-	(45. annual meeting of the Electron Microscopy Society of America, Baltimore, MD, USA, 2-7 Aug 1987)			
7	*See* LBL-23173	E 1.99: DE87010255	MN -32	12:40287
CONF-870873-	(18. conference on low temperature physics, Kyoto, Japan, 20-26 Aug 1987)			
1	NTIS, PC A02; 3	DE87009820	MN -34	12:39257
4	*See* LA-UR-87-1548	E 1.99: DE87010109	MN -34	12:39893
9	NTIS, PC A02; 3	DE87011389	MN -34	12:40113
CONF-870889-	(12. structural methods conference, Chicago, IL, USA, 3-7 Aug 1987)			
1	*See* UCRL-96738	E 1.99: DE87010805	MN -32	12:40282
CONF-8708101-	(6. international symposium on capture gamma-ray spectroscopy, Leuven, Belgium, 31 Aug-4 Sep 1987)			
2	*See* BNL-39981	E 1.99: DE87012491	MN -34C	12:40033
CONF-870946-	(5. international congress on polymers in concrete, Brighton, UK, 21-24 Sep 1987)			
1	*See* BNL-38944	E 1.99: DE87004607	MN -25	12:39253
CONF-870947-	(12. conference on the numerical simulation of plasmas, San Francisco, CA, USA, 20-23 Sep 1987)			
1	*See* DOE/ER/53223-33	E 1.99: DE87009344	MN -32	12:40140
CONF-870950-	(14. annual national American Society for Quality Control, Las Vegas, NV, USA, 14-16 Sep 1987)			
2	*See* BNL-39992	E 1.99: DE87012478	MN -13	12:40278
CONF-870960-	(33. IEEE/Holm conference, Chicago, IL, USA, 21-23 Sep 1987)			
1	*See* SAND-86-2796C	E 1.99: DE87007862	MN -25	12:39203
CONF-870988-	(16. annual conference of the North American Thermal Analysis Society, Washington, DC, USA, 27-30 Sep 1987)			
1	*See* SAND-87-0591C	E 1.99: DE87010953	MN -25	12:39204
CONF-870991-	(10. international symposium on military applications of blast simulation, Bad Reichenhall, F.R. Germany, 21-25 Sep 1987)			
1	*See* SAND-86-2180C	E 1.99: DE87010510	MN -35	12:39545
CONF-871009-	(American Society of Lubrication Engineers and the American Society of Mechanical Engineers lube conference, San Antonio, TX, USA, 5-8 Oct 1987)			
1	*See* N-87-20422			12:39230
CSE-87-012	*See* AD-A-179712/5/XAB			12:39871
DEMO-85/ 3	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702432	MN -34B	12:39588
85/ 4	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702433	MN -46	12:40099
85/ 6	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702434	MN -80	12:38905
85/ 7	NTIS (US Sales Only), PC A04/MF A01 - Library, Democritus NRC	DE87702435	MN -78	12:38906
85/ 8	NTIS (US Sales Only), PC A06/MF A01 - Library, Democritus NRC	DE87702436	MN -20	12:40138
85/ 9	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702437	MN -4	12:39317
85/ 12	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702438	MN -80	12:38907
86/ 2	NTIS (US Sales Only), PC A03/MF A01 - Library, Democritus NRC	DE87702439	MN -80	12:38908
86/ 3G	NTIS (US Sales Only), PC A06/MF A01 - Library, Democritus NRC	DE87702440	MN -41	12:38909

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
86/ 5	NTIS (US Sales Only), PC A05/MF A01 - Library, Democritus NRC	DE87702441	MN -80	12:38910
86/ 9	NTIS (US Sales Only), PC A02/MF A01 - Library, Democritus NRC	DE87702442	MN -41	12:38911
DESY-				
86-009	NTIS PC E09; Available from NTIS as TIB/B87-06446		ND -34D	12:39898
86-014	NTIS PC E11; Available from NTIS as TIB/B87-06378		ND -34D	12:39899
86-015	NTIS PC E07; Available from NTIS as TIB/B87-06443		ND -34D	12:39936
86-016	NTIS PC E07; Available from NTIS as TIB/B87-06442		ND -34D	12:39937
86-020	NTIS PC E07; Available from NTIS as TIB/B87-06445		ND -28	12:39507
86-029	NTIS PC E09; Available from NTIS as TIB/B87-06377		ND -28	12:39508
86-034	NTIS PC E09; Available from NTIS as TIB/B87-06379		ND -34D	12:39974
DFK-				
82/ 2(D)	*See* BMU-1986-106		ND -78	12:38812
86/ 1(D)	*See* BMU-1986-104		ND -11	12:39633
86/ 2(D)	*See* BMU-1986-105		ND -80	12:38893
86/ 3(D)	*See* BMU-1986-107		ND -80	12:38894
DFVLR-FB-				
86-63	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770166	MN -38	12:39353
87-02	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770167	MN -97c	12:38784
DGMK-				
202-3	NTIS PC E14; Available from NTIS as TIB/B87-08604		ND -122	12:38517
289-07	NTIS PC E14; Available from NTIS as TIB/B87-08680		ND -113	12:38459
DGRST-				
81-D-0093	NTIS (US Sales Only), PC A03; 3	DE87752666	MN -122	12:38518
81-D-1351	NTIS (US Sales Only), PC A02; 3	DE87752659	MN -103	12:38497
81-D-1352	*See* DGRST-81-D-1351	DE87752659	MN -103	12:38497
DOE/AL/10752-				
36	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010504	MN -70	12:38614
DOE/BP/14903-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010556	MN -11	12:39643
DOE/BP/16112-				
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012618	MN -95f	12:39125
DOE/BP/18946-				
T3	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012617	MN -95f	12:39126
T4	NTIS, PC A12; 3	DE87012616	MN -95f	12:39127
T5	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012622	MN -95f	12:39128
T6	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE87012621	MN -95f	12:39129
DOE/CE/15279-				
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011278	MN -60	12:38778
DOE/CE/40539-				
01	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87009318	MN -95f	12:39130
03	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87009320	MN -95f	12:39131
DOE/CE/63476-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012090	MN -13	12:39055
DOE/CE/63477-				
T5	NTIS, PC A06; 3	DE87012154	MN -95d	12:39056
DOE/CE/63496-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012078	MN -95d	12:39057
DOE/CH-				
15-0	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012335	MN -70	12:38615
DOE/CH/10274-				
1	NTIS, PC A05; 3	DE87008614	MN -70	12:38616
DOE/CS/40419-				
T1	NTIS, PC A09/M1; 1 (GPO Dep.)	E 1.99: DE87012693	MN -95f	12:39132
DOE/DP-				
0041	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011614	STD -16	12:38567
0045	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013000	MN -16	12:38670
DOE/DP/40152-				
17	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87010564	MN -21	12:40176
DOE/DP/70033-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012473	MN -13	12:40312
DOE/EIA-				
0109(87/ 04)	NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87012181	MN -98B	12:38533
0125(87/ 1Q)	NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87012642	MN -98A	12:38503
0130(87/ 04)	NTIS, PC A07/MF A01 - GPA; 1 (GPO Dep.)	E 1.99: DE87012643	MN -98C	12:38544
0191(86)	NTIS, PC A10/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87012675	MN -98E	12:39036
0226(87/ 04)	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87012957	MN -98E	12:39037
M024	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012689	MN -98	12:38494
DOE/ER-				
0296	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012825	MN -13	12:40274
0323	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012452	MN -2	12:39010
0324	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012453	MN -2	12:39011
DOE/ER/10348-				
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012475	MN -4	12:39259

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
DOE/ER/10719-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010378	MN -34B	12:39739
DOE/ER/13269-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012081	MN -4	12:39342
DOE/ER/13315-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011014	MN -38	12:39354
DOE/ER/13368-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012471	MN -4	12:38701
DOE/ER/13449-T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010968	MN -21	12:39881
DOE/ER/13467-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012101	MN -66a	12:38761
DOE/ER/13634-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010573	MN -34A	12:39882
DOE/ER/13641-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011931	MN -34	12:40114
DOE/ER/40048-23-N7	NTIS, PC A02; 3	DE87011080	MN -34C	12:39967
DOE/ER/40150-17	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87008665	MN -34C	12:40051
31	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012468	MN -34C	12:39900
DOE/ER/40200-094	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010916	MN -34	12:40128
DOE/ER/40304-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010364	MN -28	12:39491
DOE/ER/40877-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012859	MN -25	12:39260
DOE/ER/53223-32	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011088	MN -20	12:40139
33	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009344	MN -32	12:40140
34	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011280	MN -20f	12:40141
DOE/ER/53227-107	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011798	STD -20f	12:40179
DOE/ER/60876-3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87012995	MN -48	12:39696
DOE/ER/60163-3	NTIS, PC A02; 3	DE87012461	MN -48	12:39649
DOE/ER/60297-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011825	MN -11	12:39606
DOE/ER/60372-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012411	MN -11	12:39575
DOE/ER/60376-2	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87012237	MN -11	12:39733
DOE/ER/60470-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012044	MN -11	12:39607
DOE/ER/60472-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011623	MN -11	12:39718
DOE/ET/27014-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012414	MN -66	12:39719
3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012413	MN -66	12:39720
DOE/ET/51013-216	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011031	MN -20b	12:40142
217	NTIS, PC A02; 3	DE87011032	MN -20	12:40180
219	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011034	MN -20	12:40143
220	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011035	MN -20	12:40144
222	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011037	MN -20a	12:40145
DOE/EV/10450-H1	NTIS, PC A13; 3	DE87010330	STD -41	12:39058
DOE/ID/12138-6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012744	MN -95f	12:39190
DOE/ID/12650-1	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87012423	MN -85	12:38617
DOE/MA-0298	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012949	MN -13	12:40275
DOE/MC/20320-2355	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87001088	STD -109	12:38431
DOE/MC/21004-2285	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87001070	MN -109	12:38432
DOE/MC/21046-2329	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87001094	MN -109	12:38433
DOE/MC/21179-2272	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006032	MN -92	12:38540
DOE/MC/21181-1950-Vol.3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001078	MN -132	12:38541
DOE/MC/21225-2267	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87005907	MN -90	12:38434
DOE/MC/21387-2359	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87006491	STD -106	12:38498
DOE/MC/22123-2281	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87006492	STD -111	12:39119
DOE/MC/22146-2309	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87001086	STD -109	12:38435
DOE/MC/23057-2273	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006033	MN -90c	12:38436

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/MC/23167-					
2277	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001066	STD -111	12:38785
DOE/MC/23265-					
2362	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012086	MN -110	12:39048
DOE/NBM-					
7001097	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001097	STD -102	12:38423
7008223	NTIS, PC A05; 3		DE87008223	MN -95	12:39038
7012615	NTIS, PC A11; 3		DE87012615	MN -95f	12:39133
7012620	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012620	MN -95f	12:39134
7012624	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012624	MN -95f	12:39135
DOE/NV/10384-					
03	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012367	MN -11	12:39636
DOE/OR/00033-					
T250	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE87004387	MN -80	12:38844
T323	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012619	MN -2	12:40100
DOE/OR/21400-					
T300	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008024	MN -80	12:38878
DOE/PC/70786-					
T10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012710	MN -108	12:38437
DOE/PC/80523-					
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012727	MN -102	12:38438
DOE/PC/80541-					
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011984	MN -102	12:38439
DOE/PC/80911-					
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012157	MN -102	12:38460
DOE/PC/81008-					
T8	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012051	MN -105	12:38798
DOE/PC/90520-					
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012548	MN -113	12:38461
DOE/PC/90534-					
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012717	MN -108	12:38462
DOE/PC/90957-					
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012667	MN -103	12:38463
DOE/PC/90960-					
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012408	MN -102	12:38464
DOE/SF/00515-					
T77	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011307	MN -28	12:39478
DOE/SR/01052-					
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012150	MN -48	12:38720
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012151	MN -48	12:38721
DOE/SR/10702-					
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012146	MN -11	12:39671
DOE/SR/10711-					
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012149	MN -11	12:39610
DOE/TIC-					
3407	NTIS, PC A24/MF A01; 4 (GPO Dep.)	E 1.99:	DE87007069	STD -2	12:40313
DP-					
929-A1	*See* DOE/TIC-3407	E 1.99:	DE87007069	STD -2	12:40313
DP-MS-					
87-12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012384	MN -10	12:38570
87-31	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012381	MN -16	12:38671
87-42	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011176	MN -70B	12:38618
87-88	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012386	MN -70B	12:38666
DP-TR-					
95	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012686	MN -4	12:38664
DPSP-					
87-1008	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012410	MN -11	12:38619
DPSPU-					
87-30-1-Vol.1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012391	MN -11	12:39617
87-30-1-Vol.2	NTIS, PC A15; 3		DE87012392	MN -11	12:39637
DPST-					
86-743	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012634	MN -70B	12:39225
87-437	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011245	MN -38	12:39440
E-					
3033	*See* N-87-20267				12:39463
3367	*See* N-87-20422				12:39230
3386	*See* N-87-21141				12:39426
3466	*See* N-87-20425				12:39231
3469	*See* N-87-20767				12:40288
3525	*See* N-87-20382				12:39159
ED-					
115/ 151	NTIS (US Sales Only), PC A03; 3		DE87752821	MN -95f	12:39136
119/ 183	NTIS (US Sales Only), PC A03; 3		DE87752819	MN -95f	12:39137
121/ 126	NTIS (US Sales Only), PC A03; 3		DE87752820	MN -95f	12:39138
EEG-					
36	*See* DOE/AL/10752-36	E 1.99:	DE87010504	MN -70	12:38614
EEO-ED-					
17/ 69	NTIS (US Sales Only), PC A03/MF A01; 1		DE87752803	MN -95d	12:39004
105-127	NTIS (US Sales Only), PC A04/MF A01; 1		DE87752797	MN -95d	12:39059
111-64	NTIS (US Sales Only), PC A04/MF A01; 1		DE87752799	MN -95d	12:39005
112-97	NTIS (US Sales Only), PC A03/MF A01; 1		DE87752796	MN -95e	12:39139
114-142	NTIS (US Sales Only), PC A03/MF A01; 1		DE87752798	MN -95f	12:39140
116/ 166	NTIS (US Sales Only), PC A03/MF A01; 1		DE87752802	MN -95f	12:39141
118/ 169	NTIS (US Sales Only), PC A03/MF A01; 1		DE87752801	MN -95f	12:39142

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120/ 176	NTIS - JS Sales Only), PC A03/MF A01; 1		DE87752800	MN -95f	12:39143
EFN-					
20	NTIS (US Sales Only), PC A20/MF A01		DE87751965	MN -78	12:38912
EGG-					
2501	*See* NUREG/CR-4876		TI87010661	MN -80	12:38979
10282-2154	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012332	MN -11	12:39624
EGG-M-					
34386	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009720	MN -78	12:38865
35686	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012432	MN -25	12:39261
EGG-ME-					
7679	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012430	MN -71	12:38571
EGG-WM-					
7636	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012427	MN -70	12:38620
7637	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012429	MN -70	12:38621
EGG-WT-					
7610	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012428	MN -70	12:38622
EIR-					
612	NTIS (US Sales Only), PC A02/MF A01		DE87702443	MN -25	12:39191
614	NTIS (US Sales Only), PC A02/MF A01		DE87702444	MN -25	12:39192
618	NTIS (US Sales Only), PC A04/MF A01		DE87702445	MN -32	12:40284
619	NTIS (US Sales Only), PC A04/MF A01		DE87702446	MN -20	12:40181
EPA-					
520/ 5-87-005	NTIS, PC A03/MF A01		TI87900843	MN -11	12:39589
EPRI-AP-					
5273	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920445	ND -97e	12:38708
5310	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920524	ND -66a	12:38771
EPRI-CS-					
5198-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920489	ND -105	12:38799
5225	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920475	ND -107	12:39625
5271	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920486	ND -11	12:38786
5277	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920517	ND -111	12:39193
5281	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920496	ND -107	12:38800
5288	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920516	ND -108	12:38801
5296	Research Reports Center, Box, 50490, Palo Alto, CA 94303		TI87920511	ND -103	12:38499
EPRI-CS/EL-					
5251-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920514	ND -93	12:38787
EPRI-EM-					
5168	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920481	ND -95d	12:39060
5252	Reseach Reports Center, Box 50490, Palo Alto, CA 94303		TI87920452	ND -97	12:39039
5256-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920491	ND -97	12:38788
5280	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920471	ND -95d	12:39061
5285	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920505	ND -95f	12:39158
EPRI-NP-					
4786-Vols.1-2	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920242	ND -80	12:38913
4843-S	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920176	ND -80	12:38866
4869-M	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920301	ND -80	12:38867
5024	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920261	ND -80	12:38914
5096	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920313	ND -80	12:38915
5199-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920463	ND -78	12:38817
5223	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920464	ND -80	12:38916
5272	*See* NUREG/CR-4922		TI87900828	MN -78	12:38822
ESL-					
87005-JP	*See* DOE/ER/13467-T1	E 1.99:	DE87012101	MN -66a	12:38761
ETSU-B-					
1118	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -61E	12:38694
1124	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -95e	12:39144
1127	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -61A	12:38695
1129	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -61A	12:38696

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ETSU-R-				
33	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -96	12:39171
41	NTIS (US Sales Only), PC A04/MF A01; 1	DE87752795	MN -61E	12:38697
ETSU-WN-				
5022A	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -60	12:38779
5043/ 1	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -60	12:38780
EUR-				
9332	Commission of the European Communities, Luxembourg		ND -66a	12:38762
9728	Commission of the European Communities, Luxembourg		ND -41	12:39677
9931	NTIS (US Sales Only), PC A02; 3	DE87751795	MN -95	12:39145
9938	NTIS (US Sales Only), PC A03/MF A01; 1	DE87752654	MN -63	12:39226
9954	NTIS (US Sales Only), PC A03/MF A01; 1	DE87752646	MN -59	12:38756
10007	NTIS (US Sales Only), PC A22/MF A01; 1	DE87780132	MN -95d	12:39102
10015	NTIS (US Sales Only), PC A04; 1	DE87752651	MN -63	12:38722
10160-Vol.1	NTIS (US Sales Only), PC A04; 3	DE87752649	MN -95d	12:39103
10160-Vol.2	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752645	MN -95d	12:39104
10176	NTIS (US Sales Only), PC A04; 3	DE87752650	MN -66b	12:38773
10243	Commission of the European Communities, Luxembourg		ND -11	12:39590
10289	Commission of the European Communities, Luxembourg		ND -41	12:39678
10452	Commission of the European Communities, Luxembourg		ND -41	12:39679
10846-DE	*See* KFK-4172		ND -48	12:39683
FhG-W-				
11/ 85	NTIS PC E07; Available from NTIS as TIB/B87-06304		ND -25	12:39194
FNAL/Pub-				
87/ 69-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009650	MN -34B	12:39740
FNAL-TM-				
1451	NTIS, PC A02/MF A01	DE87010300	STD -28	12:39496
1455	NTIS, PC A03; 3	DE87011002	STD -28	12:39497
1459	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010999	STD -28	12:39479
1460	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010998	STD -28	12:39480
1461	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010997	STD -28	12:39481
1462	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010996	STD -28	12:39638
FRNC-TH-				
2067	NTIS (US Sales Only), PC A09; 3	DE87752669	MN -122	12:38519
2294	NTIS (US Sales Only), PC A11/MF A01	DE87752658	MN -11	12:39611
2347	NTIS (US Sales Only), PC A07/MF A01	DE87752661	MN -122	12:38525
2350	NTIS (US Sales Only), PC A09/MF A01	DE87752197	MN -25	12:39227
2351	NTIS (US Sales Only), PC A10/MF A01	DE87752662	MN -108	12:38440
2402	NTIS (US Sales Only), PC A07/MF A01	DE87752667	MN -121	12:38526
2408	NTIS (US Sales Only), PC A09/MF A01	DE87752663	MN -125	12:38527
2424	NTIS (US Sales Only), PC A06/MF A01	DE87752198	MN -124	12:38546
FRT-				
81-D-1252	NTIS (US Sales Only), PC A03/MF A01	DE87752681	MN -125	12:38539
GA-A-				
18173	NTIS, PC A02; 3	DE87010910	MN -20a	12:40182
18795	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009860	MN -20a	12:40183
GKSS-				
86/ E/ 39	NTIS PC E07; Available from NTIS as TIB/B87-09994		ND -11	12:39576
86/ E/ 51	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770162	MN -11	12:39562
86/ E/ 52	NTIS PC E07; Available from NTIS as TIB/B87-06480		ND -25	12:39195
86/ E/ 53	NTIS PC E07; Available from NTIS as TIB/B87-06463		ND -64	12:39476
86/ E/ 54	NTIS PC E07; Available from NTIS as TIB/B87-06477		ND -11	12:39629
86/ E/ 56	NTIS PC E07; Available from NTIS as TIB/B87-06481		ND -25	12:39196
86/ E/ 58	NTIS PC E07; Available from NTIS as TIB/B87-06476		ND -11	12:39577
86/ E/ 59	NTIS PC E09; Available from NTIS as TIB/B87-08661		ND -38	12:39318
87/ E/ 4	NTIS PC E07; Available from NTIS as TIB/B87-08681		ND -80	12:39197
87/ E/ 8	NTIS PC E07; Available from NTIS as TIB/B87-08672		ND -11	12:39639
GRS-A-				
806	*See* BMU-1986-126		ND -8	12:38899
962	*See* BMU-1986-117		ND -78	12:38814
1013	*See* BMU-1986-122		ND -80	12:38897
1085	*See* BMU-1986-116		ND -78	12:38813
1101	*See* BMU-1986-115		ND -80	12:38896
1147	*See* BMU-1986-129		ND -80	12:38877
1175	*See* BMU-1986-124		ND -80	12:38898
1191	*See* BMU-1986-125		ND -70	12:38602

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GSF-				
5/ 86	NTIS PC E09; Available from NTIS as TIB/B87-08448		ND -48	12:39680
32/ 86	NTIS PC E07; Available from NTIS as TIB/B87-08676		ND -70	12:38623
40/ 86	NTIS PC E15; Available from NTIS as TIB/B87-08598		ND -70	12:38624
42/ 86	NTIS (US Sales Only), PC A14; 3	DE87770208	MN -11	12:39578
43/ 86	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770212	MN -11	12:39579
GSF-BPT-				
11/ 86	NTIS (US Sales Only), PC A04/MF A01; 1	DE87770200	MN -11	12:39580
GSF-R-				
418	NTIS PC E15; Available from NTIS as TIB/B87-06258		ND -11	12:38625
GSF-T-				
256	*See* GSF-32/86		ND -70	12:38623
260	*See* GSF-40/86		ND -70	12:38624
GSI-				
86-53-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-06465		ND -4	12:39290
87-2	NTIS PC E11; Available from NTIS as TIB/B87-06415		ND -34C	12:40014
87-8-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-06361		ND -34C	12:40052
87-9-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-06360		ND -34C	12:40053
87-12-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-06363		ND -34C	12:40054
87-14-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-06362		ND -34C	12:40055
87-16-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-08668		ND -34C	12:40056
HEDL-SA-				
3304-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004090	MN -80	12:38868
3380	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010721	MN -79	12:38887
3391	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010722	MN -79b	12:38842
3410	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010729	MN -38	12:39355
3416	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010720	MN -20c	12:40184
3444	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010725	MN -20c	12:40185
3453	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010731	MN -79b	12:38917
3504	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010730	MN -79p	12:38835
3511-FP	NTIS MF A01 (GPO Dep.)	E 1.99: DE87004438	MN -80	12:38918
3665-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007437	MN -80	12:38869
IAEA-SR-				
110	NTIS (US Sales Only), PC A05/MF A01	DE87702447	MN -70	12:38628
110(Add.)	NTIS (US Sales Only), PC A02/MF A01	DE87702448	MN -70	12:38635
IAEA-TC-				
579/ 14	NTIS (US Sales Only), MF A01; 2	DE87900494	MN -78	12:38919
IEA-				
20007/ PUMA/ R/ B	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PI-00-901 Warsaw, Poland		ND -80	12:38858
IEA-SHAC-TVI-				
3-Summ.	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900817	MN -59A	12:38757
IFP-				
32-295	NTIS (US Sales Only), PC A07/MF A01; 1	DE87752668	MN -122	12:38520
32-330	NTIS (US Sales Only), PC A12/MF A01; 1	DE87752665	MN -122	12:38528
32-427	NTIS (US Sales Only), PC A10/MF A01; 1	DE87752664	MN -122	12:38532
32-680	NTIS (US Sales Only), PC A13/MF A01; 1	DE87752660	MN -121	12:38534
32-765	NTIS (US Sales Only), PC A11/MF A01; 1	DE87752670	MN -121	12:39146
33-118	NTIS (US Sales Only), PC A10/MF A01; 1	DE87752672	MN -64	12:39477
33-748	NTIS (US Sales Only), PC A09/MF A01; 1	DE87752671	MN -122	12:38521
IIUG-rep-				
85-10	NTIS (US Sales Only), PC A07/MF A01; 1	DE87770168	MN -95	12:39029
85-12	NTIS (US Sales Only), PC A04/MF A01; 1	DE87770169	MN -98	12:39006
IKDA-				
86/ 20	NTIS PC E07; Available from NTIS as TIB/B87-10187		ND -34C	12:40057
86/ 27	NTIS PC E07; Available from NTIS as TIB/B87-10186		ND -34C	12:40040
IKE-				
7-5	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770199	MN -38	12:39356
7-7	NTIS (US Sales Only), PC A09/MF A01; 1	DE87770164	MN -95d	12:39105
ILE-				
8503-P	NTIS (US Sales Only), PC A02/MF A01	DE87702449	MN -20	12:40186
ILR-MITT-				
168	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770163	MN -62a	12:38750
INIS-BR-				
612	NTIS (US Sales Only), PC A03/MF A01	DE87702450	MN -51	12:38553
613	NTIS (US Sales Only), PC A02/MF A01	DE87702451	MN -51	12:38554
614	NTIS (US Sales Only), PC A02/MF A01	DE87702452	MN -25	12:38833
615	NTIS (US Sales Only), PC A02/MF A01	DE87702453	MN -80	12:38870
617	NTIS (US Sales Only), PC A02/MF A01	DE87702454	MN -2	12:40314
618	NTIS (US Sales Only), PC A02/MF A01	DE87702455	MN -2	12:40315

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619	NTIS (US Sales Only), PC A02/MF A01	DE87702456	MN -78	12:38804
620	NTIS (US Sales Only), PC A03/MF A01	DE87702457	MN -2	12:38681
621	NTIS (US Sales Only), PC A03/MF A01	DE87702458	MN -37	12:39291
623	NTIS (US Sales Only), PC A08/MF A01	DE87702459	MN -51	12:39608
624	NTIS (US Sales Only), PC A06/MF A01	DE87702460	MN -34A	12:40115
626	NTIS (US Sales Only), PC A02/MF A01	DE87702461	MN -41	12:40109
627	NTIS (US Sales Only), PC A02/MF A01	DE87702462	MN -51	12:39721
628	NTIS (US Sales Only), PC A02/MF A01	DE87702463	MN -51	12:39722
629	NTIS (US Sales Only), PC A02/MF A01	DE87702464	MN -51	12:39723
630	NTIS (US Sales Only), PC A02/MF A01	DE87702465	MN -51	12:39724
631	NTIS (US Sales Only), PC A02/MF A01	DE87702466	MN -51	12:38555
632	NTIS (US Sales Only), PC A02/MF A01	DE87702467	MN -51	12:38556
633	NTIS (US Sales Only), PC A02/MF A01	DE87702468	MN -51	12:38557
634	NTIS (US Sales Only), PC A02/MF A01	DE87702469	MN -51	12:38558
635	NTIS (US Sales Only), PC A02/MF A01	DE87702470	MN -4	12:39292
636	NTIS (US Sales Only), PC A02/MF A01	DE87702471	MN -51	12:38559
637	NTIS (US Sales Only), PC A02/MF A01	DE87702472	MN -51	12:38560
638	NTIS (US Sales Only), PC A02/MF A01	DE87702473	MN -51	12:38561
639	NTIS (US Sales Only), PC A02/MF A01	DE87702474	MN -51	12:38562
640	NTIS (US Sales Only), PC A02/MF A01	DE87702475	MN -11	12:39640
641	NTIS (US Sales Only), PC A02/MF A01	DE87702476	MN -51	12:39618
642	NTIS (US Sales Only), PC A02/MF A01	DE87702477	MN -4	12:39731
643	NTIS (US Sales Only), PC A02/MF A01	DE87702478	MN -51	12:39293
644	NTIS (US Sales Only), PC A02/MF A01	DE87702479	MN -51	12:38563
645	NTIS (US Sales Only), PC A02/MF A01	DE87702480	MN -80	12:38871
646	NTIS (US Sales Only), PC A02/MF A01	DE87702481	MN -4	12:39725
647	NTIS (US Sales Only), PC A02/MF A01	DE87702482	MN -20	12:40187
651	NTIS (US Sales Only), PC A02/MF A01	DE87702483	MN -48	12:39653
INIS-mf-				
10256	NTIS PC E14; Available from NTIS as TIB/B87-10096		ND -25	12:39228
10279	NTIS PC E15; Available from NTIS as TIB/B87-10206		ND -10	12:38572
10613	NTIS PC E07; Available from NTIS as TIB/B87-06103		ND -11	12:39603
10614	NTIS PC E11; Available from NTIS as TIB/B87-06104		ND -80	12:38920
10616	NTIS (US Sales Only), PC A10/MF A01	DE87752239	MN -80	12:38921
10620	NTIS (US Sales Only), PC A05/MF A01	DE87752241	MN -80	12:38922
10621	NTIS (US Sales Only), PC A05/MF A01	DE87752242	MN -80	12:38927
10622	NTIS (US Sales Only), PC A03/MF A01	DE87752243	MN -80	12:38836
10623	NTIS (US Sales Only), PC A04/MF A01	DE87752244	MN -80	12:38933
10624	NTIS (US Sales Only), PC A05/MF A01	DE87752240	MN -80	12:38939
10630	NTIS PC E14; Available from NTIS as TIB/B87-06248		ND -34C	12:40101
10632	NTIS (US Sales Only), PC A12/MF A01	DE87752245	MN -34B	12:39728
10650	NTIS PC E99; Available from NTIS as TIB/B87-08191		ND -80	12:38946
10675	NTIS PC E07; Available from NTIS as TIB/B87-08345		ND -38	12:39357
10678	NTIS PC E14; Available from NTIS as TIB/B87-10161		ND -4	12:39294
10682	NTIS PC E11; Available from NTIS as TIB/B87-10154		ND -10	12:38573
10689	NTIS PC E14; Available from NTIS as TIB/B87-09987		ND -80	12:38947
10692	NTIS PC E09; Available from NTIS as TIB/B87-10189		ND -48	12:39651
10693	NTIS PC E11; Available from NTIS as TIB/B87-09986		ND -77	12:38827
10892	NTIS (US Sales Only), PC A07/MF A01	DE87702484	MN -48	12:39665
10893	NTIS (US Sales Only), PC A08/MF A01	DE87702485	MN -32	12:38859
10894	NTIS (US Sales Only), PC A04/MF A01	DE87702486	MN -86	12:38565
10895	NTIS (US Sales Only), PC A05/MF A01	DE87702487	MN -41	12:40111
10906	NTIS (US Sales Only), PC A02/MF A01	DE87702488	MN -23	12:38683
10911	NTIS (US Sales Only), PC A06/MF A01	DE87702489	MN -34C	12:39998
10913	NTIS (US Sales Only), PC A03/MF A01	DE87702490	MN -41	12:38668
10914	NTIS (US Sales Only), PC A03/MF A01	DE87702491	MN -20	12:40188
10915	NTIS (US Sales Only), PC A17/MF A01	DE87751946	MN -78	12:40319
INS-				
564	NTIS (US Sales Only), PC A02/MF A01	DE87702492	MN -34C	12:40083
568	NTIS (US Sales Only), PC A02/MF A01	DE87702493	MN -34C	12:40084
585	NTIS (US Sales Only), PC A02/MF A01	DE87702494	MN -34C	12:40085
586	NTIS (US Sales Only), PC A11/MF A01	DE87702495	MN -34C	12:40086
588	NTIS (US Sales Only), PC A03/MF A01	DE87702496	MN -34C	12:40021
592	NTIS (US Sales Only), PC A03/MF A01	DE87702497	MN -34C	12:40087
IPP-				
1/ 239	NTIS PC E07; Available from NTIS as TIB/B87-10162		ND -20d	12:40189
5/ 13	NTIS PC E07; Available from NTIS as TIB/B87-10164		ND -20a	12:40146
III/ 114	NTIS PC E11; Available from NTIS as TIB/B87-08674		ND -20f	12:40147

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III/ 116	NTIS PC E11; Available from NTIS as TIB/B87-06310		ND -20f	12:40148
IPPJ-				
761	NTIS (US Sales Only), PC A03/MF A01	DE87702498	MN -20	12:40149
763	NTIS (US Sales Only), PC A02/MF A01	DE87702499	MN -20	12:40150
765	NTIS (US Sales Only), PC A03/MF A01	DE87702500	MN -20	12:40151
767	NTIS (US Sales Only), PC A02/MF A01	DE87702501	MN -20	12:40152
770	NTIS (US Sales Only), PC A03/MF A01	DE87702502	MN -20	12:40209
779	NTIS (US Sales Only), PC A04/MF A01	DE87702503	MN -20	12:40153
IPPJ-DT-				
123	NTIS (US Sales Only), PC A02/MF A01	DE87702504	MN -20	12:40154
125	NTIS (US Sales Only), PC A05/MF A01	DE87702505	MN -20	12:40155
127	NTIS (US Sales Only), PC A05/MF A01	DE87702506	MN -20	12:40156
128	NTIS (US Sales Only), PC A05/MF A01	DE87702507	MN -20	12:40157
IS-				
4935	*See* DOE/NBM-7001097	E 1.99: DE87001097	STD -102	12:38423
ISH-				
90	NTIS PC E09; Available from NTIS as TIB/B87-06307		ND -48	12:39682
94	NTIS PC E15; Available from NTIS as TIB/B87-08603		ND -4	12:39338
101	NTIS PC E11; Available from NTIS as TIB/B87-06451		ND -4	12:39295
ITEF-				
47(1986)	NTIS (US Sales Only), PC A03/MF A01	DE87702508	MN -34B	12:39744
JAERI-M-				
86-071	NTIS (US Sales Only), PC A04/MF A01	DE87702509	MN -34C	12:40106
86-083	NTIS (US Sales Only), PC A03/MF A01	DE87702510	MN -77	12:38828
86-101	NTIS (US Sales Only), PC A10/MF A01	DE87702511	MN -80	12:38808
86-102	NTIS (US Sales Only), PC A02/MF A01	DE87702512	MN -51	12:39619
86-105	NTIS (US Sales Only), PC A03/MF A01	DE87702513	MN -20	12:38684
86-110	NTIS (US Sales Only), PC A04/MF A01	DE87702514	MN -20	12:40210
86-111	NTIS (US Sales Only), PC A06/MF A01	DE87702515	MN -41	12:38948
86-112	NTIS (US Sales Only), PC A11/MF A01	DE87702516	MN -28	12:39482
86-115	NTIS (US Sales Only), PC A02/MF A01	DE87702517	MN -20	12:40158
86-116	NTIS (US Sales Only), PC A04/MF A01	DE87702518	MN -34C	12:40048
86-117	NTIS (US Sales Only), PC A05/MF A01	DE87702519	MN -77	12:38879
86-119	NTIS (US Sales Only), PC A04/MF A01	DE87702520	MN -77	12:38829
86-121	NTIS (US Sales Only), PC A08/MF A01	DE87702521	MN -34C	12:40000
86-123	NTIS (US Sales Only), PC A03/MF A01	DE87702522	MN -71	12:39358
86-124	NTIS (US Sales Only), PC A04/MF A01	DE87702523	MN -32	12:40211
86-125	NTIS (US Sales Only), PC A11/MF A01	DE87702524	MN -2	12:38861
86-126	NTIS (US Sales Only), PC A03/MF A01	DE87702525	MN -78	12:38819
86-128	NTIS (US Sales Only), PC A02/MF A01	DE87702526	MN -20	12:40159
86-130	NTIS (US Sales Only), PC A02/MF A01	DE87702527	MN -20	12:40212
86-131	NTIS (US Sales Only), PC A06/MF A01	DE87702528	MN -70	12:38640
86-133	NTIS (US Sales Only), PC A02/MF A01	DE87702529	MN -20	12:40213
86-135	NTIS (US Sales Only), PC A06/MF A01	DE87702530	MN -78	12:38949
86-160	NTIS (US Sales Only), PC A03/MF A01	DE87702531	MN -20	12:40160
86-161	NTIS (US Sales Only), PC A03/MF A01	DE87702532	MN -20	12:40214
JINR-E-				
2-86-437	NTIS (US Sales Only), PC A02/MF A01	DE87702533	MN -34D	12:39948
Juel-				
2078	NTIS PC E11; Available from NTIS as TIB/B87-06472		ND -20d	12:40215
2081	NTIS PC E11; Available from NTIS as TIB/B87-06460		ND -25	12:39198
2085	NTIS PC E09; Available from NTIS as TIB/B87-06455		ND -77	12:38830
2086	NTIS PC E09; Available from NTIS as TIB/B87-10163		ND -20d	12:40216
2088	NTIS PC E07; Available from NTIS as TIB/B87-10207		ND -25	12:39199
2092	NTIS PC E14; Available from NTIS as TIB/B87-06276		ND -25	12:39200
2096	NTIS PC E15; Available from NTIS as TIB/B87-08456		ND -34C	12:39229
2097	NTIS PC E09; Available from NTIS as TIB/B87-06469		ND -20f	12:40161
2098	NTIS (US Sales Only), PC A08/MF A01; 1	DE87770203	MN -11	12:39563
2099	NTIS PC E11; Available from NTIS as TIB/B87-08649		ND -70	12:38641
2105	NTIS PC E15; Available from NTIS as TIB/B87-08455		ND -77	12:38831
2106	NTIS PC E09; Available from NTIS as TIB/B87-08678		ND -38	12:39425
2114	NTIS PC E11; Available from NTIS as TIB/B87-10165		ND -20d	12:40217
Juel-Spez-				
375	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770201	MN -11	12:39581
383	NTIS PC E07; Available from NTIS as TIB/B87-08452		ND -77	12:38832
K/ETAC-				
22	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012451	MN -22	12:39262

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K/ITP-				
103	NTIS, PC A02/MF A01; 1	DE87012239	MN -15	12:38672
104	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012322	MN -15	12:38673
105	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012323	MN -15	12:38674
K/OA-				
6076	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009814	MN -22	12:38566
KEK-				
86-3	NTIS (US Sales Only), PC A03/MF A01	DE87702534	MN -28	12:39509
KFK-				
3768	NTIS PC E14; Available from NTIS as TIB/B87-08675		ND -78	12:38820
4163	NTIS PC E11; Available from NTIS as TIB/B87-06359		ND -34C	12:40107
4166	NTIS PC E09; Available from NTIS as TIB/B87-08671		ND -37	12:39513
4167	NTIS (US Sales Only), PC A07; 3	DE87770211	MN -11	12:39564
4169	NTIS PC E07; Available from NTIS as TIB/B87-06275		ND -25	12:39263
4170	NTIS PC E99; Available from NTIS as TIB/B87-06320		ND -80	12:38969
4172	NTIS PC E15; Available from NTIS as TIB/B87-06454		ND -48	12:39683
4179	NTIS PC E07; Available from NTIS as TIB/B87-06404		ND -13	12:40316
4186	NTIS PC E17; Available from NTIS as TIB/B87-08659		ND -2	12:39025
4199	NTIS PC E09; Available from NTIS as TIB/B87-08670		ND -79	12:38839
4200	NTIS PC E14; Available from NTIS as TIB/B87-08453		ND -38	12:39359
4202	NTIS PC E07; Available from NTIS as TIB/B87-08596		ND -70	12:38642
4207	NTIS PC E99; Available from NTIS as TIB/B87-10132		ND -13	12:40280
4210	NTIS PC E11; Available from NTIS as TIB/B87-10152		ND -20d	12:40218
4211	NTIS PC E11; Available from NTIS as TIB/B87-10185		ND -34D	12:39903
4219	NTIS PC E07; Available from NTIS as TIB/B87-08669		ND -10	12:38574
4246	NTIS PC E11; Available from NTIS as TIB/B87-10184		ND -34C	12:40012
KFK-PEF-				
10	NTIS (US Sales Only), PC A11; 3	DE87770205	MN -11	12:39697
13	NTIS (US Sales Only), PC A18/MF A01; 1	DE87770248	MN -11	12:39013
KGRD-				
16-REV	*See* PB-87-183281/XAB			12:38508
KMSF-U-				
1728	*See* DOE/DP/40152-17	E 1.99: DE87010564	MN -21	12:40176
KTA-GS-				
51	NTIS PC E09; Available from NTIS as TIB/B87-08679		ND -80	12:38970
KURRI-TR-				
278	NTIS (US Sales Only), PC A04/MF A01	DE87702535	MN -41	12:38971
L-				
16271	*See* N-87-20522			12:39393
LA-				
10881-PR	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012700	MN -13	12:39021
10985-MS	*See* NUREG/CR-4904	TI87010787	MN -80	12:38981
10986-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012706	STD -34B	12:39874
10988-MS	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE87012708	STD -98	12:39007
10999	NTIS, PC A02/MFA01 (GPO Dep.)	E 1.99: DE87011269	MN -10	12:38575
11002-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012698	STD -15	12:38675
11011-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012697	STD -11	12:39732
11029-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012695	STD -48	12:39650
11042-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012082	MN -11	12:39644
11049-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87012393	MN -4	12:39391
11070-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012415	MN -70	12:38643
11076-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012378	MN -4	12:39296
11081-PR	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012352	MN -70	12:38644
LA-UR-				
86-4356	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003759	MN -32	12:40285
87-156	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005104	MN -34B	12:40131
87-782	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007477	MN -34C	12:40088
87-1418	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009011	MN -34	12:40127
87-1480	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010099	MN -28	12:39392
87-1548	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010109	MN -34	12:39893
87-1563	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010111	MN -32	12:40286
87-1623	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010118	MN -94a	12:39000
87-1793	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010139	MN -34B	12:39745
87-1935	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011785	MN -13	12:39553
87-1955	NTIS, PC A02/MFA01; 1 (GPO Dep.)	E 1.99: DE87011782	MN -41	12:39684
87-1995	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011776	MN -34B	12:39746
87-2010	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011773	MN -34B	12:39747

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87-2126	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011746	MN -34C	12:39904
87-2127	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011745	MN -34C	12:40089
87-2132	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011744	MN -34B	12:39748
87-2221	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011731	MN -34B	12:39349
87-2228	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011730	MN -34	12:40116
87-2233	NTIS, PC A02; 3	DE87011729	MN -34	12:40117
LBL-				
19149	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010984	MN -32	12:40317
22211	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009153	MN -28	12:40219
22266	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011092	MN -28	12:39498
22636	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011221	MN -32	12:40318
23007	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011095	MN -28	12:39499
23173	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010255	MN -32	12:40287
23302	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011212	MN -34B	12:39749
23323	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87010975	MN -28	12:39492
23373	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012033	MN -34B	12:39750
23413	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011227	MN -28	12:39483
23463	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010983	MN -38	12:39343
23469	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012885	MN -34B	12:39905
23474	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012819	MN -25	12:39201
23630	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012877	MN -34C	12:38568
23665	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87012817	MN -25	12:39202
LBL-PUB-				
615	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87012028	MN -13	12:40276
MF-				
114	*See* DOE/ER/53223-32	E 1.99: DE87011088	MN -20	12:40139
115	*See* DOE/ER/53223-34	E 1.99: DE87011280	MN -20f	12:40141
MISU-CM-				
68	NTIS (US Sales Only), PC A03/MF A01	DE87751948	MN -41	12:39591
MRC-R-				
1006	*See* AD-A-179741/4/XAB			12:39877
MTL-TR-				
87-7	*See* AD-A-179912/1/XAB			12:39252
N-				
87-20267	NTIS, PC A01/MF A01			12:39463
87-20382	NTIS, PC A02/MF A01			12:39159
87-20422	NTIS, PC A02/MF A01			12:39230
87-20425	NTIS, PC A02/MF A01			12:39231
87-20522	NTIS, PC A13/MF A01			12:39393
87-20689	NTIS, PC A02/MF A01			12:39875
87-20767	NTIS, PC A02/MF A01			12:40288
87-20871	NTIS, PC A19/MF A01			12:39751
87-21141	NTIS, PC A10/MF A01			12:39426
NAGRA-NTB-				
85-17	Nagra, CH-5401 Baden, Switzerland		ND -70	12:38645
86-27	Nagra, CH-5401 Baden, Switzerland		ND -70	12:38646
NAMC-AML-AE-				
540001	*See* AD-A-995466/0/XAB			12:39552
NAMRL-OL-				
87-2	*See* AD-A-180107/5/XAB			12:39716
NAS-				
1.15:86589	*See* N-87-20689			12:39875
1.15:88981	*See* N-87-20422			12:39230
1.15:89820	*See* N-87-20425			12:39231
1.15:89823	*See* N-87-20767			12:40288
1.15:89857	*See* N-87-20382			12:39159
1.55:2433	*See* N-87-20267			12:39463
1.55:2442	*See* N-87-20871			12:39751
1.55:2456	*See* N-87-20522			12:39393
1.55:2465	*See* N-87-21141			12:39426
NASA-CP-				
2433	*See* N-87-20267			12:39463
2442	*See* N-87-20871			12:39751
2456	*See* N-87-20522			12:39393
2465	*See* N-87-21141			12:39426
NASA-TM-				
86589	*See* N-87-20689			12:39875
88981	*See* N-87-20422			12:39230
89820	*See* N-87-20425			12:39231
89823	*See* N-87-20767			12:40288
89857	*See* N-87-20382			12:39159
NIPER-				
247	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE87001252	STD -125	12:39319
NIRS-AR-				
28	NTIS (US Sales Only), PC A10/MF A01	DE87702536	MN -2	12:39685
NMRDI-				
2-74-4327	NTIS, PC A07/MF A01 - New Mexico Research and Development Institute, 1220 South St., Francis Drive, Santa Fe, NM 87501; 1	DE87900904	MN -122	12:38522
2-74-4331	NTIS, PC A06/MF A01 - New Mexico Research and Development Institute, 1220 South St., Francis Dr., Santa Fe, NM 87501; 1	DE87900903	MN -116	12:38491
NOSC/TD-				
1036	*See* AD-A-179817/2/XAB			12:39568

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NP-				
7752234	NTIS (US Sales Only), PC A07/MF A01; 1	DE87752234	MN -38	12:39427
7752235	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752235	MN -98	12:39031
7752236	NTIS (US Sales Only), PC A07; 3	DE87752236	MN -97c	12:38789
7752237	NTIS (US Sales Only), PC A06/MF A01; 1	DE87752237	MN -95d	12:39106
7752610	NTIS (US Sales Only), PC A04/MF A01	DE87752610	MN -11	12:39014
7752611	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752611	MN -97	12:39040
7752612	NTIS (US Sales Only), PC A05/MF A01; 1	DE87752612	MN -11	12:39604
7752613	NTIS (US Sales Only), PC A03/MF A01; 1	DE87752613	MN -95	12:39030
7752615	NTIS (US Sales Only), PC A03/MF A01; 1	DE87752615	MN -11	12:39582
7752616	NTIS (US Sales Only), PC A03/MF A01; 1	DE87752616	MN -38	12:39471
7770094	NTIS (US Sales Only), PC A08; 3	DE87770094	MN -95d	12:39147
7770126	NTIS (US Sales Only), PC A08; 3	DE87770126	MN -121	12:38529
7770127	NTIS (US Sales Only), PC A08; 3	DE87770127	MN -116	12:38495
7770128	NTIS (US Sales Only), PC A05; 3	DE87770128	MN -48	12:39698
7770129	NTIS (US Sales Only), PC A12; 3	DE87770129	MN -94cb	12:39003
7770130	NTIS (US Sales Only), PC A07; 3	DE87770130	MN -107	12:38489
7770131	NTIS (US Sales Only), PC A14; 3	DE87770131	MN -4	12:38686
7770132	NTIS (US Sales Only), PC A09; 3	DE87770132	MN -4	12:38687
7770139	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770139	MN -95d	12:39027
7770140	NTIS (US Sales Only), PC A13; 3	DE87770140	MN -48	12:39706
7770142	NTIS (US Sales Only), PC A11/MF A01; 1	DE87770142	MN -38	12:39360
7770143	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770143	MN -11	12:39565
7770144	NTIS (US Sales Only), PC A09/MF A01; 1	DE87770144	MN -11	12:39566
7770145	NTIS (US Sales Only), PC A18/MF A01; 1	DE87770145	MN -116	12:38496
7770146	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770146	MN -122	12:38523
7770147	NTIS (US Sales Only), PC A02/MF A01; 1	DE87770147	MN -38	12:39361
7770148	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770148	MN -121	12:39033
7770149	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770149	MN -122	12:38524
7770150	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770150	MN -98	12:39032
7770151	NTIS (US Sales Only), PC A02/MF A01; 1	DE87770151	MN -96	12:39162
7770152	NTIS (US Sales Only), PC A08/MF A01; 1	DE87770152	MN -122	12:38507
7770153	NTIS (US Sales Only), PC A08/MF A01; 1	DE87770153	MN -38	12:39362
7770154	NTIS (US Sales Only), PC A11/MF A01; 1	DE87770154	MN -38	12:39264
7770155	NTIS (US Sales Only), PC A08/MF A01; 1	DE87770155	MN -132	12:38545
7770156	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770156	MN -11	12:39583
7770158	NTIS (US Sales Only), PC A09; 3	DE87770158	MN -11	12:39734
7770159	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770159	MN -105	12:38802
7770161	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770161	MN -38	12:39428
7770165	NTIS (US Sales Only), PC A13/MF A01; 1	DE87770165	MN -11	12:39626
7770196	NTIS (US Sales Only), PC A09; 3	DE87770196	MN -11	12:39707
7770197	NTIS (US Sales Only), PC A09/MF A01; 1	DE87770197	MN -11	12:39708
7770198	NTIS (US Sales Only), PC A02/MF A01; 1	DE87770198	MN -58	12:38723
7770202	NTIS (US Sales Only), PC A14; 3	DE87770202	MN -11	12:39022
7770204	NTIS (US Sales Only), PC A07; 3	DE87770204	MN -11	12:39584
7770206	NTIS (US Sales Only), PC A2; 3	DE87770206	MN -63	12:38724
7770207	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770207	MN -11	12:39605
7770210	NTIS (US Sales Only), PC A06; 3	DE87770210	MN -05	12:39034
7770246	NTIS (US Sales Only), PC A09/MF A01; 1	DE87770246	MN -48	12:39709
7770247	NTIS (US Sales Only), PC A08; 3	DE87770247	MN -25	12:39441
7770249	NTIS (US Sales Only), PC A11/MF A01; 1	DE87770249	MN -95f	12:39148
7770250	NTIS (US Sales Only), PC A13; 3	DE87770250	MN -95e	12:39149
7770251	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770251	MN -38	12:39429
7900890	Fish & Wildlife Res. Center, 1010 Gause Blvd., Slidell, LA 70458	TI87900890	MN -11	12:39627
NRL-				
9038	*See* AD-A-179999/8/XAB			12:39389
NUREG-				
0020-Vol.10-No.12	NTIS, PC A19 - GPO	DE87900838	MN -80	12:38805
0040-Vol.10-No.4	NTIS, PC A12/MF A01 - GPO	TI87900547	MN -80	12:38845
0040-Vol.11-No.1	NTIS, PC A11/MF A01 - GPO	TI87900815	MN -80	12:38846
0540-Vol.9-No.5	NTIS, PC A15 - GPO	DE87900889	MN -2	12:38847
0936-Vol.5-No.3	NTIS, PC A07/MF A01 - GPO	TI87900483	MN -80	12:38848
0936-Vol.5-No.4	NTIS, PC A08/MF A01 - GPO	TI87900763	MN -2	12:39026
0940-Vol.6-No.1	NTIS, PC A15/MF A01 - GPO	TI87900814	MN -80	12:38972
1100-Vol.3-Add.	NTIS, PC A03/MF A01 - GPO	TI87900836	MN -80	12:38849
1211	NTIS, PC A04/MF A01 - GPO	TI87900529	MN -80	12:38973
1269	NTIS, PC A06/MF A01 - GPO	TI87900823	MN -78	12:38974
NUREG/BR-				
0111	NTIS, PC A03/MF A01 - GPO	TI87900917	MN -71	12:38576
NUREG/CP-				
0087	NTIS, PC A03/MF A01 - GPO	TI87011025	MN -80	12:38883
NUREG/CR-				
2331-Vol.6-No.2	NTIS, PC A06/MF A01 - GPO	TI87005050	MN -80	12:38975
4527-1	NTIS, PC A06/MF A01; 1	TI87010751	MN -80	12:38976
4718	NTIS, PC A03/MF A01 - GPO	TI87005170	MN -80	12:38875
4751-Vols.1-2	*See* EPRI-NP-4786-Vols.1-2	TI87920242	ND -80	12:38913
4815	NTIS, PC A05/MF A01 - GPO	TI87900591	MN -80	12:38977
4819-Vol.1	NTIS, PC A04/MF A01 - GPO	TI87007688	MN -80	12:38978
4876	NTIS PC E06/MF A01 - GPO	TI87010661	MN -80	12:38979
4899	NTIS, PC A08/MF A01 - GPO	TI87008495	MN -80	12:38980
4904	NTIS, PC A03/MF A01 - GPO	TI87010787	MN -80	12:38981
4922	NTIS, PC A10/MF A01 - GPO	TI87900828	MN -78	12:38822
4973	NTIS, PC A05/MF A01 - GPO	TI87900902	MN -11	12:39729

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OAEP-					
87	NTIS (US Sales Only), PC A02/MF A01		DE87702537	MN -34B	12:39726
OCS/MMS-					
87-0016	Minerals Management Service, P.O. Box 101159, Anchorage, AK 99510		TI87900894	MN -11	12:38505
87-0047	NTIS, PC A03/MF A01; 1		DE87900887	MN -98	12:39035
OITS-					
318	*See* DESY-86-015			ND -34D	12:39936
ORNL-					
6320	NTIS, PC A05; 3		DE87012004	MN -11	12:39630
ORNL/M-					
350	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012334	MN -34	12:39363
ORNL/Sub-					
83-28915/ 4/ V1	*See* NUREG/CR-4819-Vol.1		TI87007688	MN -80	12:38978
84-47989/ 2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011975	MN -95d	12:39107
87-38435C/ 1&28	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012294	MN -71	12:38577
ORNL/TM-					
1168/ R2-1/ 87	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005584	MN -80	12:38983
9838	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011969	MN -11	12:39614
10307	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011956	MN -11	12:39645
10349	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007796	MN -80	12:38888
10350	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007798	MN -80	12:38889
10438	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87011707	MN -11	12:39622
10471	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012520	MN -4	12:39455
PATENTS-US-	(US: Commissioner of Patents, Washington, DC 20231, USA, $1.50 per copy.)				
4,670,239					12:39334
4,670,883					12:39413
4,672,207					12:39524
PB-					
87-141644/ XAB	NTISPC$23.00/MF$16.50				12:39163
87-141669/ XAB	NTISPC$31.50/MF$16.50				12:39164
87-141701/ XAB	NTISPC$23.00/MF$16.50				12:39165
87-141719/ XAB	NTISPC$24.50/MF$16.50				12:39166
87-141727/ XAB	NTISPC$77.00/MF$17.50				12:39167
87-141750/ XAB	NTISPC$158.00/MF$20.50				12:39168
87-141784/ XAB	NTISPC$56.50/MF$16.50				12:39169
87-172367/ XAB	NTISPC$37.50/MF$16.50				12:39170
87-175014/ XAB	NTIS, PC A02/MF A01				12:38441
87-178380/ XAB	NTIS, PC A03/MF A01				12:39472
87-182689/ XAB	NTIS, PC A02/MF A01				12:38442
87-183208/ XAB	NTIS, PC A03/MF A01				12:39631
87-183281/ XAB	NTIS, PC A06/MF A01				12:38508
87-183695/ XAB	NTIS, PC A03/MF A01				12:39615
87-185054/ XAB	NTIS, PC A12/MF A01				12:39018
87-185062/ XAB	NTIS, PC A21/MF A01				12:39019
87-185567/ XAB	NTIS, PC A02/MF A01				12:39120
87-186094/ XAB	NTIS PC PC E05/MF E04				12:39410
87-186375/ XAB	NTIS, PC A06/MF A01				12:39860
87-186821/ XAB	NTIS, PC A05/MF A01				12:39632
87-186854/ XAB	NTIS, PC A09/MF A01				12:39121
87-187720/ XAB	NTIS, PC A04/MF A01				12:39122
87-190286/ XAB	NTIS, PC A21/MF A01				12:38537
PFC/CP-					
87-1	NTIS, PC A02/MF A01; 1		DE87900826	MN -20	12:40220
87-4	*See* DOE/ET/51013-216	E 1.99:	DE87011031	MN -20b	12:40142
87-5	*See* DOE/ET/51013-217		DE87011032	MN -20	12:40180
87-7	*See* DOE/ET/51013-219	E 1.99:	DE87011034	MN -20	12:40143
87-8	*See* DOE/ET/51013-220	E 1.99:	DE87011035	MN -20	12:40144
87-10	*See* DOE/ET/51013-222	E 1.99:	DE87011037	MN -20a	12:40145
PINSTECH/HPD-					
112	NTIS (US Sales Only), PC A02/MF A01		DE87702538	MN -37	12:39514
PNL-					
5972	*See* NUREG/CR-4718		TI87005170	MN -80	12:38875
6160	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013219	MN -95c	12:39150
6238	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012501	MN -11	12:39585
PNL-SA-					
13266	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012063	MN -61	12:38698
13704	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003174	MN -80	12:38840
14030	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011992	MN -59A	12:38751
14058	NTIS, PC A02; 3		DE87011157	MN -38	12:39364
14337	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012062	MN -11	12:39108
14440	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011141	MN -38	12:39365
14508	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012164	MN -70	12:38647
14640	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012165	MN -11	12:39015
14671	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011991	MN -95d	12:39109
14680	NTIS, PC A02; 3		DE87011142	MN -78	12:38809
14684	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011990	MN -41	12:39686
14688	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012159	MN -4	12:39297
14689	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012160	MN -4	12:39298
14821	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011143	MN -78	12:38648
14836	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012166	MN -70	12:38649
14861	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011987	MN -11	12:39727
14967	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011986	MN -98	12:39008

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
PPA-CR-				
11	NTIS (US Sales Only), PC A02/MF A01 - Nuclear Energy Unit, Kompleks PUSPATI, 43000 Kajang (MY)	DE87702539	MN -23	12:38685
PTB-Dos-				
15	NTIS PC E07; Available from NTIS as TIB/B87-06270		ND -37	12:39515
PTB-SE-				
11	NTIS PC E07; Available from NTIS as TIB/B87-06268		ND -70	12:38650
PTB-W-				
32	NTIS (US Sales Only), PC A03/MF A01; 1	DE87770157	MN -45	12:39543
PWA-				
107/ 86	*See* KFK-4219		ND -10	12:38574
RCM-				
01385	NTIS PC E07; Available from NTIS as TIB/B87-08677		ND -80	12:38884
RCNP-P-				
68	NTIS (US Sales Only), PC A04/MF A01	DE87702540	MN -28	12:39500
69	NTIS (US Sales Only), PC A05/MF A01	DE87702541	MN -2	12:39484
70	NTIS (US Sales Only), PC A05/MF A01	DE87702542	MN -2	12:39485
72	NTIS (US Sales Only), PC A07/MF A01	DE87702543	MN -2	12:39486
73	NTIS (US Sales Only), PC A06/MF A01	DE87702544	MN -34C	12:40090
74	NTIS (US Sales Only), PC A05/MF A01	DE87702545	MN -34C	12:40001
75	NTIS (US Sales Only), PC A09/MF A01	DE87702546	MN -34C	12:40002
77	NTIS (US Sales Only), PC A06/MF A01	DE87702547	MN -28	12:39487
78	NTIS (US Sales Only), PC A07/MF A01	DE87702548	MN -34C	12:40091
RDL-				
26	*See* AD-A-179987/3/XAB			12:39715
REG/G-				
1.8-Rev.2	Nuclear Regulatory Commission, Washington, DC 20555	TI87900831	MN -80	12:38850
1.134-Rev.2	United States Regulatory Commission, Washington, DC 20555	TI87900825	MN -80	12:38851
1.149-Rev.1	Nuclear Regulatory Commission, Washington, DC 20555	TI87900830	MN -80	12:38852
REPT-				
86BO536	*See* N-87-20871			12:39751
RERF-TR-				
4-83	NTIS (US Sales Only), PC A02/MF A01	DE87702549	MN -48	12:39687
13-83	NTIS (US Sales Only), PC A02/MF A01	DE87702550	MN -48	12:39688
22-85	NTIS (US Sales Only), PC A02/MF A01	DE87702551	MN -48	12:39689
RFP-				
4036	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012301	STD -11	12:38667
RIFP-				
606	NTIS, PC A03; 3	DE87900795	MN -34C	12:40092
RISO-M-				
2623	NTIS (US Sales Only), PC A03/MF A01	DE87751930	MN -41	12:38984
2626	NTIS (US Sales Only), PC A04/MF A01	DE87751931	MN -48	12:39673
2633	NTIS (US Sales Only), PC A03/MF A01	DE87751933	MN -28	12:40281
RISO-R-				
499	NTIS (US Sales Only), PC A08/MF A01	DE87751932	MN -41	12:39544
RKS-				
86-10	NTIS (US Sales Only), PC A02/MF A01	DE87751966	MN -78	12:38985
86-12	NTIS (US Sales Only), PC A02/MF A01	DE87751967	MN -78	12:38986
86-16	NTIS (US Sales Only), PC A03/MF A01	DE87751968	MN -78	12:38987
86-20	NTIS (US Sales Only), PC A02/MF A01	DE87751969	MN -78	12:38988
RRK-				
86-5	NTIS (US Sales Only), PC A02/MF A01	DE87702552	MN -34B	12:39861
86-16	NTIS (US Sales Only), PC A02/MF A01	DE87702553	MN -34B	12:39862
86-17	NTIS (US Sales Only), PC A02/MF A01	DE87702554	MN -34B	12:39863
86-28	NTIS (US Sales Only), PC A02/MF A01	DE87702555	MN -34B	12:39864
86-29	NTIS (US Sales Only), PC A02/MF A01	DE87702556	MN -34B	12:39865
SAND-				
83-2145	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012828	MN -2	12:39442
85-0917	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86015384	MN -20g	12:40277
85-1964	NTIS, PC A07; 3	DE87012508	MN -70	12:38651
85-7112	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99: DE87012573	MN -70	12:38652
85-7210	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012344	MN -70	12:38653
86-0336	*See* NUREG/CR-4527-1	TI87010751	MN -80	12:38976
86-0790	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011574	MN -32	12:39345
86-1555	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012845	STD -25	12:39446
86-1648C	NTIS, PC A02; 3	DE87006120	MN -80	12:38989
86-1676C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006130	MN -78	12:38990
86-1959C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009846	MN -62b	12:38752
86-2180C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010510	MN -35	12:39545
86-2515	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011579	MN -15	12:39016
86-2559C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006711	MN -20a	12:40221
86-2658C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012103	MN -25	12:39233
86-2796C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007862	MN -25	12:39203
86-2875C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003790	MN -38	12:39430
86-2892C	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87004242	MN -80	12:38885
86-7036-Vol.2	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87012022	MN -63	12:38746
86-7182	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012342	MN -60	12:38781

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
86-7183	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012316	MN -60	12:38782
87-0021C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010475	MN -38	12:39366
87-0022C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010497	MN -32	12:40289
87-0083C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011060	MN -28	12:39501
87-0131	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012315	STD -59A	12:38753
87-0150	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011612	MN -28	12:39488
87-0267	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011610	MN -32	12:40290
87-0349C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007023	MN -21	12:40222
87-0472	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012947	MN -70	12:38654
87-0482C	NTIS, PC A02; 3		DE87010493	MN -21	12:39367
87-0584C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008646	MN -32	12:40291
87-0591C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010953	MN -25	12:39204
87-0608C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010780	MN -78	12:38991
87-0646C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010685	MN -38	12:39368
87-0649C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011062	MN -34	12:40292
87-0668C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012134	MN -25	12:39177
87-0726C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011315	MN -34	12:40293
87-0764C	NTIS, PC A02; 3		DE87011724	MN -45	12:39546
87-0773C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011319	MN -34	12:40118
87-0810C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007863	MN -38	12:39369
87-0864C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007843	MN -38	12:39370
87-0868C	NTIS, PC A02; 3		DE87010436	MN -38	12:39205
87-0915C	NTIS, PC A02; 3		DE87012133	MN -25	12:39265
87-0930C	NTIS, PC A02; 3		DE87012406	MN -25	12:39537
87-0933C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012136	MN -4	12:39266
87-0947	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012844	STD -15	12:38676
87-0948	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012843	STD -15	12:38677
87-0955C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012404	MN -25	12:39206
87-1021C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012018	MN -15	12:38678
87-1039C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012010	MN -15	12:38679
87-1041C	NTIS, PC A02; 3		DE87012364	MN -25	12:39207
87-1124C	NTIS, PC A02; 3		DE87011635	MN -63	12:38747
87-1268C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010744	MN -37	12:39538
87-1583C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012013	MN -15	12:38680
87-1656C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012017	MN -25	12:39267
87-1703C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012401	MN -25	12:39208
87-1744C	NTIS, PC A02; 3		DE87012732	MN -71	12:38578
87-1809C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012012	MN -15	12:38655
87-7008	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011581	MN -63	12:38725
87-7106C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011721	MN -11	12:39017
SCEGIT-					
86-108	*See* AD-A-180117/4/XAB				12:39609
SEPRAD-					
05/ 86	NTIS (US Sales Only), PC A02/MF A01		DE87702557	MN -70	12:38656
SERI/MR-					
260-3124	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011804	MN -58	12:38709
SERI/PR-					
211-3115	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001162	STD -63	12:38726
SERI/SP-					
217-2950	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001150	STD -60	12:38783
SERI/STR-					
211-3147	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001174	STD -63	12:38727
231-3135	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87001190	MN -61	12:38702
231-3136	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001192	MN -61	12:38703
231-3137	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001191	MN -61	12:38728
231-3139	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001188	MN -61	12:38704
231-3141	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001187	MN -61	12:38705
231-3177	NTIS, PC A08; 3		DE87001197	MN -61	12:38729
231-3178	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001198	MN -61	12:38730
231-3185	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012264	MN -61	12:38699
SERI/TP-					
231-3161	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001194	MN -61	12:38731
SG-					
511-PT-1	*See* PB-87-186375/XAB				12:39860
SKB-PLAN-					
86	NTIS (US Sales Only), PC A05/MF A01		DE87751945	MN -70	12:38657
SKB-TR-					
85-08	NTIS (US Sales Only), PC A06/MF A01		DE87751952	MN -70	12:38658
SLAC-PUB-					
3890-Rev.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010539	MN -28	12:39447
4101	NTIS, PC A02; 3		DE87010321	MN -28	12:39502
4199	NTIS, PC A02; 3		DE87010319	MN -28	12:39493
4208	NTIS, PC A02; 3		DE87010318	MN -28	12:39489
4270	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010545	MN -34D	12:39949
4297	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010315	MN -28	12:39517
4303	NTIS, PC A02; 3		DE87010844	MN -28	12:39503
4317	NTIS, PC A02; 3		DE87010845	MN -28	12:39518
SRO-					
819-17	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012054	MN -11	12:39646
SSI-					
85-07	NTIS (US Sales Only), PC A03/MF A01		DE87751950	MN -41	12:38992
86-21	NTIS (US Sales Only), PC A02/MF A01		DE87751949	MN -41	12:38993
86-25	NTIS (US Sales Only), PC A04/MF A01		DE87751970	MN -41	12:38994

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
STEV-				
1986-10	NTIS (US Sales Only), PC A17/MF A01	DE87751972	MN -2	12:38853
1986-11	NTIS (US Sales Only), PC A04/MF A01	DE87751973	MN -2	12:38810
1986-R11	NTIS (US Sales Only), PC A06/MF A01	DE87751953	MN -2	12:39045
1986-R12	NTIS (US Sales Only), PC A03/MF A01	DE87751954	MN -2	12:38790
1986-R13	NTIS (US Sales Only), PC A03/MF A01	DE87751955	MN -2	12:38791
1986-R14	NTIS (US Sales Only), PC A04/MF A01	DE87751956	MN -2	12:38792
1986-R15	NTIS (US Sales Only), PC A05/MF A01	DE87751957	MN -2	12:38854
1986-R16	NTIS (US Sales Only), PC A05/MF A01	DE87751958	MN -2	12:39041
1986-R17	NTIS (US Sales Only), PC A06/MF A01	DE87751959	MN -2	12:38793
1986-R18	NTIS (US Sales Only), PC A05/MF A01	DE87751960	MN -2	12:38995
1986-R19	NTIS (US Sales Only), PC A05/MF A01	DE87751961	MN -2	12:38855
1986-R20	NTIS (US Sales Only), PC A12/MF A01	DE87751962	MN -2	12:38794
1986-R21	NTIS (US Sales Only), PC A05/MF A01	DE87751963	MN -2	12:38795
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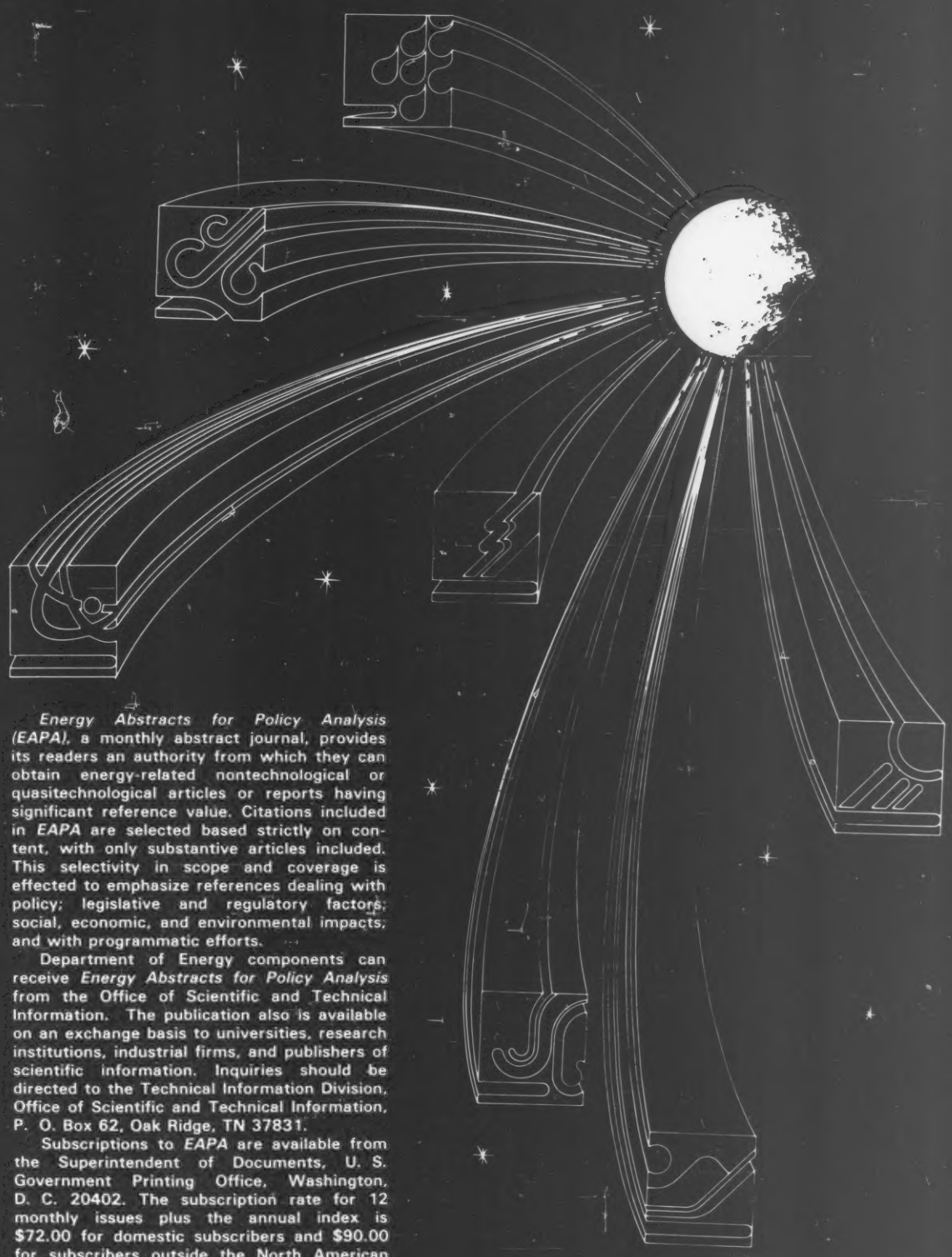

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